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# Methods for determining goals and expectations for fielded jet engines

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# NAVAL POSTGRADUATE SCHOOL
## MONTEREY, CALIFORNIA


# THESIS

**METHODS FOR DETERMINING GOALS AND EXPECTATIONS FOR FIELDED JET ENGINES**

by

John A. Malsbury

December, 1995

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This thesis investigates methods for determining goals and expectations for fielded jet engines. Some of these methods employ concepts used in Reliability Centered Maintenance (RCM). The procedures developed here can be applied to any fielded jet engine. The data used by this thesis was extracted from the Naval Aviation Logistics Data Analysis (NALDA) database. The desktop software programs that were used to attain reliability parameters are readily available to any command. The data analysis accomplished here demonstrated that cannibalization of engines has impacted adversely on reliability. A model was developed to determine no-build times for jet engines at the Intermediate Maintenance and Depot level of repair based on engine reliability and the conditional probabilities of survival of significant components of the engine and their specified maximum operating times.

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**METHODS FOR DETERMINING GOALS AND EXPECTATIONS FOR FIELDED JET ENGINES**

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Submitted in partial fulfillment of the
requirements for the degree of

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## ABSTRACT

This thesis investigates methods for determining goals and expectations for fielded jet engines. Some of these methods employ concepts used in Reliability Centered Maintenance (RCM). The procedures developed here can be applied to any fielded jet engine. The data used by this thesis was extracted from the Naval Aviation Logistics Data Analysis (NALDA) database. The desktop software programs that were used to attain reliability parameters are readily available to any command. The data analysis accomplished here demonstrated that cannibalization of engines has impacted adversely on reliability. A model was developed to determine no-build times for jet engines at the Intermediate Maintenance and Depot level of repair based on engine reliability and the conditional probabilities of survival of significant components of the engine and their specified maximum operating times.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| $\theta$ | Theta - Weibull Distribution Scale Parameter |
| $\beta$ | Beta - Weibull Distribution Shape Parameter |
| A/C | Aircraft |
| ASO | Aviation Supply Office |
| CDF | Cumulative Distribution Function |
| CIP | Component Improvement Program |
| CR | Cannibalization |
| DMC | Defense Megacenter |
| ERAP | Engine Reliability Analysis Program |
| FHSN | Flight Hour Since New |
| FHSR | Flight Hour Since Repair |
| HEMP | Hourly Engine Maintenance Program |
| HPT | High Pressure Turbine |
| HSI | Hot Section Inspection |
| HT | Hard Time |
| IMA | Intermediate Maintenance Activity |
| LPT | Low Pressure Turbine |
| MEI | Major Engine Inspection |
| MIM | Maintenance Instruction Manual |
| MTBF | Mean Time Between Failure |
| NADEP | Naval Aviation Depot |
| NALDA | Naval Aviation Logistics Data Analysis |
| NAWCADPPE | Naval Air Warfare Center Aircraft Division and Power Engineering |
| P/REASON | Previous Reason for Removal |

## LIST OF ABBREVIATIONS

| | |
|---|---|
| PDF | Probability Density Function |
| RAP | Reliability Analysis Program |
| RCM | Reliability Centered Maintenance |
| REA-REM | Reason for Removal |
| REM-UIC | Removal Unit Identification Code |
| SERNO | Serial Number |
| SI | Significant Item |
| SSC | Status Star Code |
| STD DEV | Standard Deviation |

# I. INTRODUCTION

## A. BACKGROUND

### 1. Reliability Analysis Program

For the past decade, the Component Improvement Program (CIP) has been an important element in aircraft logistical support of aircraft engines. In the face of declining Navy budgets, it is vital to improve maintenance programs for aircraft engines and make full use of engine failure data in the process. A primary purpose of this thesis is to develop analytical tools that can be used to conduct analysis of segments of the TF34 engine data base to enhance maintenance and logistics decision making.

A first step in this effort approach was the Reliability Analysis Program (RAP). [Ref. 1: p. 4]

> The program seeks to reduce the risks of catastrophic failures and loss of engine and/or airframe. This requires better estimates of engine and hence component's reliability. While that program is mainly focused on developing a better Reliability Centered Maintenance (RCM) program, it will also provide a baseline from which to seek improvements in the "ilities." [Ref. 1: p. 4]

This thesis focuses on supporting the Engine Reliability Analysis Program (ERAP) in conjunction with the RCM program. The engine selected for analysis is the TF34 Turbofan jet engine which powers the S-3 aircraft.

### 2. Engine Reliability Analysis Program (ERAP)

The Naval Air Warfare Center Aircraft Division and Power Engineering (NAWCADPPE) was tasked with analyzing and reporting factors that influence engine reliability. The database used in the ERAP program is the Naval Aviation Logistics Data

Analysis (NALDA) database. The ERAP information is ultimately used by engine management teams to develop sound management policy designed to enhance engine reliability. [Ref. 2: p. 1]

### 3. Naval Aviation Logistics Data Analysis (NALDA)

NALDA is an operational Automated Information System that is a centralized Aviation 3M data bank used on an interactive basis with logisticians, engineers, analysts, and staff. Secondary sources to NALDA are the Naval Aviation Depots (NADEP) and the Aviation Supply Office (ASO). The computer services are provided by the Defense Megacenter (DMC) Mechanicsburg, PA. [Ref. 3]

## B. RESEARCH QUESTIONS

The specific ERAP information, such as engine reason for removal and Flight Hours Since Repair (FHSR), of the five year data base can be used to address the following questions:

1. Has cannibalization had less adverse impact on TF34 engine reliability in recent years?

2. Does the reliability of TF34 engines decrease as the number of repairs increase?

3. How can cost effective no-build times be chosen for significant engine components that have designated hard inspection/repair times?

## C. METHODOLOGY OF DATA ANALYSIS

The five-year database was divided into one-year segments as indicated below and the following analysis conducted:

1. Construct engine failure data sets that will be used to assess the effect of cannibalization subsequent time to failure. This analysis is performed on the five year data base as a whole, on individual fiscal years, and on the most recent two fiscal years combined.

2. For each fiscal year and the most recent two fiscal years of the TF34 data base, remove small engine failure times on an incremental basis to develop different categories of data sets that will be analyzed.

The categories are defined as follows:

- **All** (all failure times)
- **Less Zero** (delete failure times that have zero FHSR)
- **Less 10%** (delete the first 10% of the failure times starting with the lowest FHSR records first)
- **Less 50% < 100 FHSR** (delete 50% of the failure times that are less than 100 FHSR)
- **Less 80% < 100 FHSR** (delete 80% of the failure times that are less than 100 FHSR)

For each data set, the Mean Time Between Failure (MTBF) was calculated using two different procedures. One procedure uses a parametric approach that fits a Weibull distribution to the population of failure times in the data set. The second procedure computes the MTBF non-parametrically. A more detailed description of these two procedures is provided in Chapter II.

3. Plot the number of cannibalization removals each year.

4. For each data set, compute and analyze reliability values and conditional reliability values.

5. Develop models for computing cost effective no-build times for Significant Items that have been assigned maximum operating times. These items have a no-build time limit used to determine when a replacement component will be installed into an engine that is undergoing repair even though the maximum operating time has not been accumulated on the Significant Item. These models employ conditional survival probabilities of Significant Items and reliabilities of the TF34 engines.

## D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

The scope of this research is focused on the TF34 engine. Particular attention was taken with respect to the fiscal year when an engine was removed. This resulted in deleting some record entries that fall outside the fiscal years 1990 to 1994. For example, engines having been removed September 1994 is a relevant data record. However, an engine removed October 1994 would be deleted because the removal occurred in fiscal 1995. The author of this thesis assumes that readers posses knowledge of statistical analysis and spreadsheet software functions, logic, and procedures. The spreadsheet software program utilized with this thesis is Microsoft Excel version 5.0.

# II. THE AFFECTS OF LOW FAILURE TIMES AND CANNIBALIZATION ON TF34 ENGINE MTBF

## A. PROCEDURES FOR DATA ANALYSIS AND STATISTICAL CALCULATIONS

The analysis of the influence that low failure times and engine cannibalization actions have on MTBF was done from a NALDA database sort for fiscal years 1990 to 1994 for the TF34 engine. The data was in the form of ERAP reports, Removal/Downgrades and Flight Hours Between Repairs. The data was converted to an Excel spreadsheet and established a working data base of 1812 engine records. [Ref. 2] This data is presented in detailed form in Appendix A. A statistical data comparison was performed for each fiscal year. Failure times that had non-failure engine removal reasons were deleted from the data set which left a data set with only actual engine failure times. Specifically, these removal codes were 3E (faulty handling), 4B (accidental/incidental damage), 4D (directed removal by Type Commander), 4L (damaged in transit), 5G (overhaul-hightime), 6A (modification-technical directive incorporation), 7C (high-time component only), 7D (high-time COMP/HEMP/HSI), and 3W (cannibalization). The engine population presented in Table 1 represents engine failure conditions (turbine failure, engine seizure, compressor blades cracked, etc.) previously defined in Caudill's thesis [Ref. 2] less 26 records for no flight hour entry and engine removals occurring in fiscal year 1995 resulting in 697 total engine records. The mathematical formulas used to compute MTBF are applicable to any engine failure condition. That is, any reason for removal can isolate an engine population to which the formulas and spreadsheet procedures illustrated in Appendix B can be applied. It is important to note that because the removal

codes cited above have been removed from the original data set, the remaining time between removals are actually time between engine failures. Therefore, Mean Time Between Removal, MTBR is really MTBF, Mean Time Between Failure.

## B. THE CONVENTION FOR DELETING ENGINE RECORDS

The convention on how engine records were deleted to develop the different data categories are listed below. The values of beta and theta of the fitted Weibull distribution and the MTBF and STD DEV of the population of failure times is given in Table 1.

| | |
|---|---|
| **Weibull** | **All**: Consists of all the failure data in the data set using the Weibull formulas. |
| **Nonpara** | **All**: Consists of all the failure data in the data set using the Non-Parametric formulas. |
| **Weibull** | **Less zero:** The failure times in this category that had a zero entry in the Flight Hour Since Repair (FHSR) cell and was deleted from the data set. |
| **Non-Par** | **Less zero:** The same set of data that was used to compute Weibull - less zero is used here. However, the Non-Parametric equations are used to calculate MTBF and the standard deviation. |
| **Weibull** | **Less 10%**: N = Engine Population. N - (.10*N). The convention is to delete the failure times in ascending order starting at zero and ending at (.10*N). This would delete the lowest FHSR times first. |
| **Nonpara** | **Less 10%:** The same set of data that was used to compute Weibull - less 10% is used here. However, the Non-Parametric equations are used to calculate MTBF and the standard deviation. |
| **Weibull** | **Less 50% < 100**: 50% of FHSR, less that a 100 hours, are deleted from the data set. The lowest failure times are deleted first. |
| **Nonpara** | **Less 50% < 100**: The same set of data that was used to compute Weibull - less 50% < 100. However, the Non-Parametric formulas are used to calculate MTBF and the standard deviation. |
| **Weibull** | **Less 80% < 100**: 80% of FHSR, less that a 100 hours, are deleted from the data set. The lowest failure times are deleted first. |
| **Nonpara** | **Less 80% < 100**: The same set of data that was used to compute Weibull - less 80% < 100. However, the Non-Parametric formulas are used to calculate MTBF and the standard deviation. |

| FY90-FY94 | # of records | BETA | THETA | MTBF | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 697 | 1.2032 | 515.36 | 484.28 | 403.75 |
| Nonpara - All | 697 | | | 477.65 | 420.88 |
| Weibull - less zero | 659 | 1.3009 | 555.68 | 513.32 | 398.57 |
| Nonpara - less zero | 659 | | | 505.19 | 416.46 |
| Weibull - less 10% | 627 | 1.3884 | 590.08 | 538.50 | 392.64 |
| Nonpara - less 10% | 627 | | | 530.79 | 410.84 |
| Weibull - less 50% < 100 | 613 | 1.4821 | 605.00 | 549.93 | 390.61 |
| Nonpara - less 50% < 100 | 613 | | | 542.59 | 407.93 |
| Weibull - less 80% < 100 | 563 | 1.5771 | 659.56 | 591.79 | 385.23 |
| Nonpara - less 80% < 100 | 563 | | | 587.11 | 396.04 |

| FY90 | # of records | BETA | THETA | MTBF | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 172 | 0.9705 | 405.28 | 398.61 | 398.61 |
| Nonpara - All | 172 | | | 411.34 | 420.77 |
| Weibull - less zero | 161 | 1.0554 | 449.86 | 440.81 | 415.03 |
| Nonpara - less zero | 161 | | | 439.44 | 420.47 |
| Weibull - less 10% | 155 | 1.1039 | 474.83 | 458.32 | 413.68 |
| Nonpara - less 10% | 155 | | | 456.34 | 419.48 |
| Weibull - less 50% < 100 | 146 | 1.1784 | 512.82 | 484.92 | 413.61 |
| Nonpara - less 50% < 100 | 146 | | | 483.54 | 417.20 |
| Weibull - less 80% < 100 | 130 | 1.3198 | 583.04 | 537.20 | 412.02 |
| Nonpara - less 80% < 100 | 130 | | | 538.00 | 410.33 |

| FY91 | # of records | BETA | THETA | MTBF | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 148 | 1.2557 | 556.59 | 518.40 | 413.22 |
| Nonpara - All | 148 | | | 506.64 | 441.11 |
| Weibull - less zero | 139 | 1.3834 | 605.89 | 552.92 | 407.07 |
| Nonpara - less zero | 139 | | | 539.44 | 435.25 |
| Weibull - less 10% | 133 | 1.4746 | 638.84 | 578.15 | 399.78 |
| Nonpara - less 10% | 133 | | | 563.66 | 429.37 |
| Weibull - less 50% < 100 | 129 | 1.5061 | 649.81 | 585.91 | 398.02 |
| Nonpara - less 50% < 100 | 129 | | | 580.89 | 424.47 |
| Weibull - less 80% < 100 | 118 | 1.7264 | 721.46 | 643.13 | 384.44 |
| Nonpara - less 80% < 100 | 118 | | | 632.15 | 407.44 |

**Table 1. TF34 Database Statistical Analysis**

| FY92 | # of records | BETA | THETA | MTBF | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 157 | 1.3068 | 551.34 | 509.31 | 391.67 |
| Nonpara - All | 157 | | | 500.90 | 411.68 |
| Weibull - less zero | 152 | 1.3644 | 573.63 | 524.68 | 391.28 |
| Nonpara - less zero | 152 | | | 517.37 | 408.05 |
| Weibull - less 10% | 141 | 1.4975 | 622.83 | 562.60 | 383.75 |
| Nonpara - less 10% | 141 | | | 555.98 | 398.52 |
| Weibull - less 50% < 100 | 142 | 1.4852 | 618.38 | 558.59 | 384.74 |
| Nonpara - less 50% < 100 | 142 | | | 552.43 | 399.35 |
| Weibull - less 80% < 100 | 133 | 1.6002 | 658.76 | 590.20 | 378.62 |
| Nonpara - less 80% < 100 | 133 | | | 585.48 | 391.13 |

| FY93 | # of records | BETA | THETA | MTBF | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 120 | 1.3402 | 537.01 | 493.55 | 370.26 |
| Nonpara - All | 120 | | | 483.53 | 393.60 |
| Weibull - less zero | 117 | 1.3877 | 553.88 | 505.46 | 368.55 |
| Nonpara - less zero | 117 | | | 495.92 | 390.85 |
| Weibull - less 10% | 108 | 1.5397 | 604.94 | 544.52 | 361.19 |
| Nonpara - less 10% | 108 | | | 536.85 | 378.99 |
| Weibull - less 50% < 100 | 108 | 1.5397 | 604.94 | 544.52 | 361.19 |
| Nonpara - less 50% < 100 | 108 | | | 536.85 | 378.99 |
| Weibull - less 80% < 100 | 102 | 1.6489 | 639.2 | 571.88 | 354.4 |
| Nonpara - less 80% < 100 | 102 | | | 566.40 | 369.16 |

| FY94 | # of records | BETA | THETA | MTBF | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 99 | 1.2900 | 553.3 | 512.48 | 398.93 |
| Nonpara - All | 99 | | | 498.91 | 429.62 |
| Weibull - less zero | 89 | 1.5285 | 634.62 | 571.23 | 382.64 |
| Nonpara - less zero | 89 | | | 554.97 | 417.23 |
| Weibull - less 10% | 89 | 1.5285 | 634.62 | 571.23 | 382.64 |
| Nonpara - less 10% | 89 | | | 554.97 | 417.23 |
| Weibull - less 50% < 100 | 87 | 1.5815 | 650.97 | 584.97 | 376.5 |
| Nonpara - less 50% < 100 | 87 | | | 567.64 | 413.39 |
| Weibull - less 80% < 100 | 80 | 1.7834 | 708.39 | 633.78 | 358.68 |
| Nonpara - less 80% < 100 | 80 | | | 615.45 | 396.56 |

| FY93-94 | # of records | BETA | THETA | MTBF | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 219 | 1.3208 | 545.23 | 502.36 | 381.6 |
| Nonpara - All | 219 | | | 490.48 | 409.41 |
| Weibull - less zero | 206 | 1.4447 | 588.58 | 533.71 | 374.07 |
| Nonpara - less zero | 206 | | | 521.43 | 402.53 |
| Weibull - less 10% | 197 | 1.5372 | 618.82 | 557.01 | 369.48 |
| Nonpara - less 10% | 197 | | | 545.13 | 395.66 |
| Weibull - less 50% < 100 | 195 | 1.5585 | 625.57 | 562.16 | 367.63 |
| Nonpara - less 50% < 100 | 195 | | | 550.64 | 393.90 |
| Weibull - less 80% < 100 | 181 | 1.7163 | 672.93 | 599.86 | 362.8 |
| Nonpara - less 80% < 100 | 181 | | | 590.91 | 380.13 |

**Table 1. TF34 Database Statistical Analysis**

## C. NON-PARAMETRIC AND WEIBULL METHODS AND ANALYSIS

The Weibull and Non-Parametric formulas and spreadsheet procedures are explained in Appendix B.

### 1. Non-Parametric Approach

> It is often the case in practical applications that a specific distribution assumption is not tenable. In these circumstances, it is desirable to base inferences on tests that are valid over a wide range of distributions of the parent population. Such tests are called Non-Parametric, or distribution free. [Ref. 4: p. 413]

In this approach, all inferences are drawn from the working data base using Non-Parametric statistics. Consequently, inferences about performance measures are not susceptible to criticism relevant to an assumed probability distribution. [Ref. 2: p. 4] The approach to establish a Non-Parametric probability distribution was to arrange the time between repairs in ascending order for the respective fiscal years for the time between repair and apply equation (6), of Appendix B, along with the corresponding spreadsheet procedure. This approach was used to compute MTBF of the TF34 engine for each of the individual fiscal years and their different categories. The results of these calculations are presented in Table 1.

### 2. Weibull Approach

The Non-Parametric method of analysis is not as useful as parametric analysis for some types of advanced analysis. Therefore, a parametric analysis was performed to provide a fit of a Weibull distribution to the data. The Weibull distribution can be used to model the distribution of failure times for an item that has a wear-in, wear-out, or neither. The mathematical equations (1) - (5) that describe the method for fitting a Weibull distribution to the population of failure times for each data set along with their

corresponding spreadsheet procedures are given in Appendix B. Additionally, Appendix B describes how estimates of the two parameters $\theta$ (theta) and $\beta$ (beta) for the Weibull distribution were obtained. The results of the Weibull distribution parameter computations are provided in Table 1.

## D. THE WEIBULL DISTRIBUTION

The fitted Probability Density Function (PDF) of a continuous random variable, T, can be used to compute all probabilities about the random variable. In particular, the reliability function, R(t), is the area under the density function beyond t. Nearly all density functions have parameters. The Weibull distribution is characterized by two parameters, $\theta$ and $\beta$. The reliability function for the Weibull distribution is $R(t) = e^{-(t/\theta)^{\beta}}$. The parameter $\beta$ is the shape parameter. If $\beta = 1$, then the Weibull distribution is an Exponential distribution. For $\beta = 3.25$ or larger, the Weibull distribution approximates a Normal density function. [Ref. 5: p. 69] A graphical illustration of this is in Figure 1. For the data set FY90 All in Table 1, $\beta = .9705$. When the shape parameter is less than one, the curve will be an extremely steep declining curve and has the y-axis as an asymptote at $t = 0$. Manufacturers consider this case to be an indication of parts failing during a wear-in period. [Ref. 5: p. 69] Relating this to the TF34 this could indicate parts failing shortly after repair or correcting faults made during repair. For the FY94 less 50% data set in Table 1, $\beta = 1.5815$ and $\theta = 650.97$. Figure 1, displays Weibull PDF for these two parameter values. Additionally, Figure 1 shows that the Weibull PDF for $\beta = 3.25$ approximates a Normal density function. The spreadsheet procedures used to produce Figure 1 are described in Appendix B.

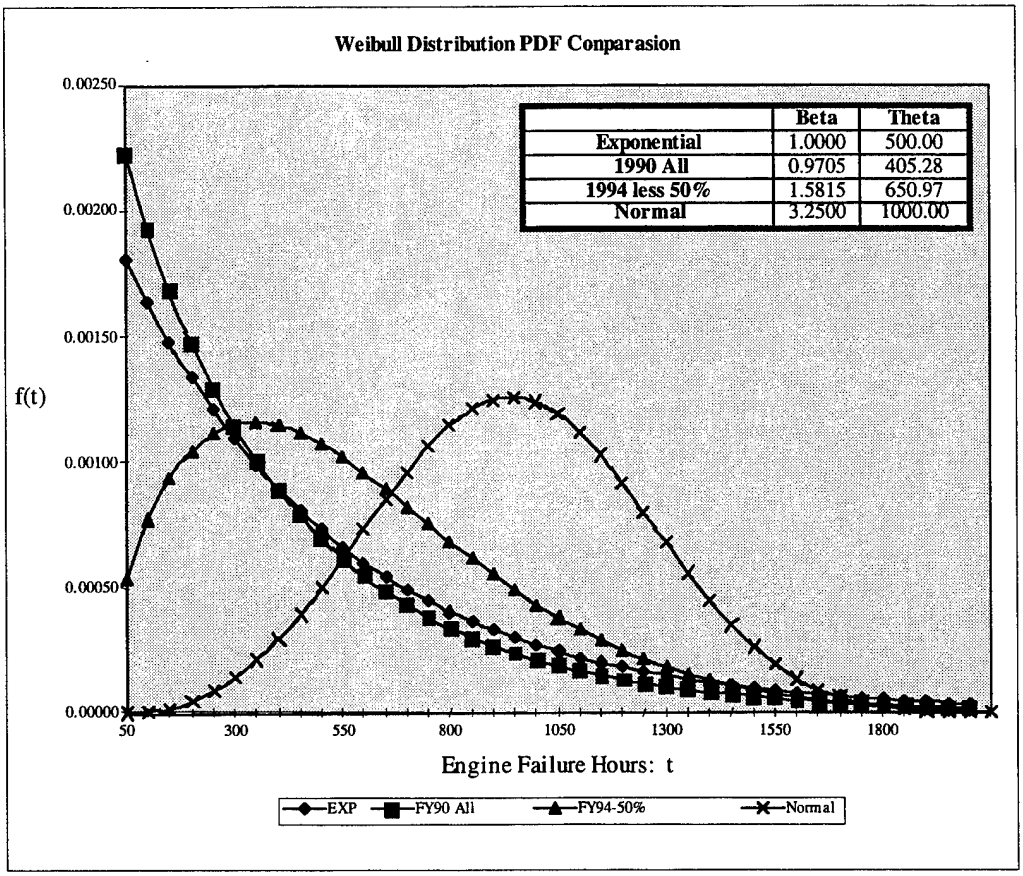



**Figure 1. Weibull PDF**

## E. IMPACT OF LOW FAILURE TIMES ON MTBF

Certain goals could be targeted to increase MTBF with respect to low failure times on the TF34 engine. For example, the MTBF for the FY 93-94 All data set in Table 1, is 502 flight hours. This number is a consequence of the current maintenance policy. Incremental reductions (deletions) in low failure times were made for this same data set and the resulting MTBFs computed. The incremental increases in MTBF are shown in Figure 2. These increases in MTBF are significant. The reason the data is so sensitive to low failure time removal is because they represent such a large

| FY93-94 | Theta | Beta | MTBF Base | MTBF Increment | % Increase |
|---|---|---|---|---|---|
| Weibull All | 545.23 | 1.3208 | 502.4 | 0.0 | 0% |
| Weibull Less Zero | 588.58 | 1.4447 | 533.7 | 31.3 | 6% |
| Weibull - Less 10% | 618.82 | 1.5372 | 557.0 | 54.6 | 11% |
| Weibull - Less 50% <100 | 625.57 | 1.5585 | 562.2 | 59.8 | 12% |
| Weibull - Less 80% <100 | 672.93 | 1.7163 | 599.9 | 97.5 | 19% |

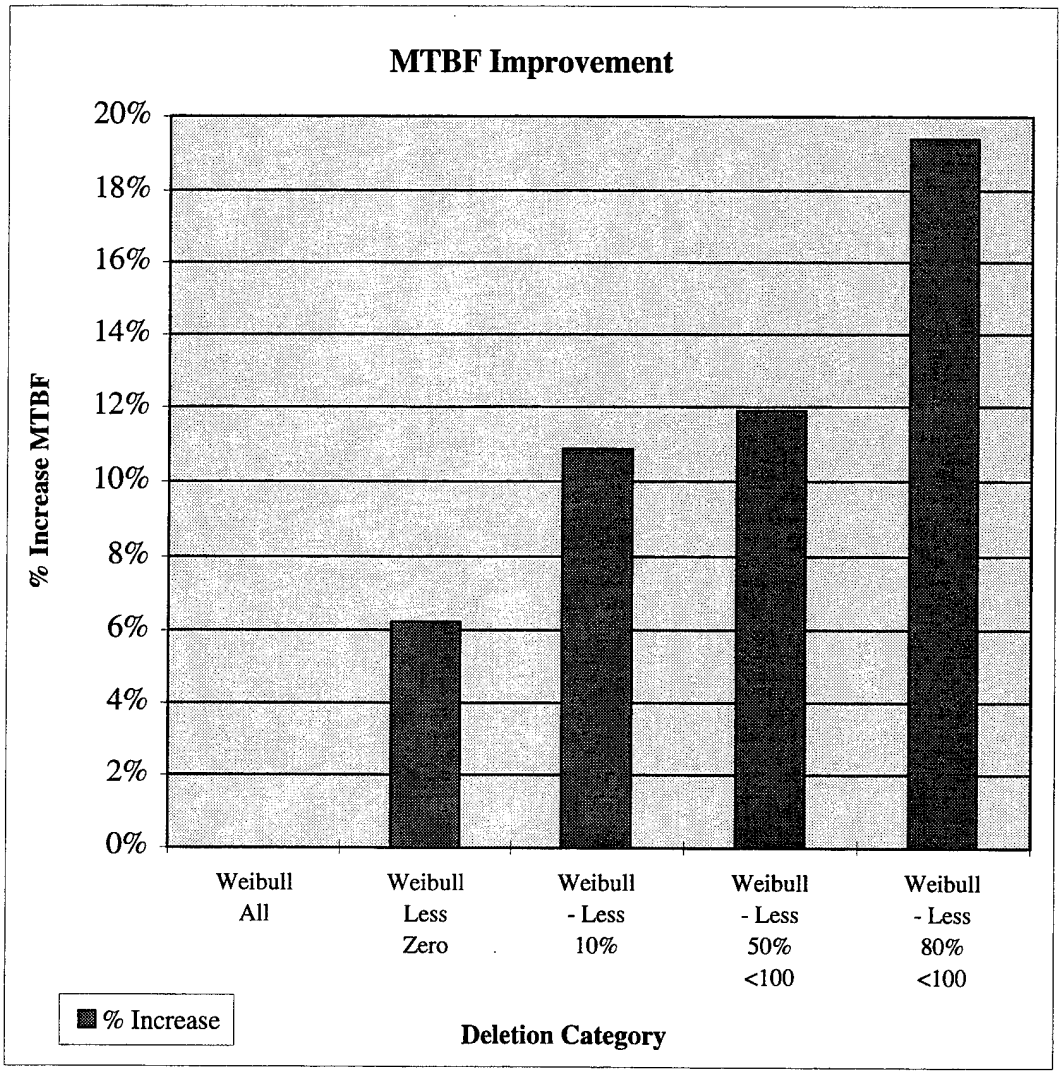



**Figure 2. MTBF Improvements with Low Failure Time Reductions**

portion of the five year TF34 database. Therefore, if an engine manager could implement changes in maintenance policies that significantly reduces engine low failure times he could increase MTBF and reliability significantly. For example, if he were successful in removing 80% of the low failure times less than 100 FHSR, he would effect an increase in MTBF from 502 hours to 600 hours (a 19% increase). The values for theta and beta were previously computed for fiscal years 93-94 and were presented in Table 1. Section D of this chapter presented the reliability function for the Weibull distribution is $R(t) = e^{-(t/\theta)^{\beta}}$. Therefore, the corresponding change in reliability at 300 hours, R(300), would increase from .6349 to .7788 (a 14% increase). These reliability values are computed using a spreadsheet with the Weibull distribution reliability function programmed into it. The reliability results are presented in Table 2. The left two columns pertain to the 1993-94 Weibull-All data set. The right two columns pertain to the 1993-94 Weibull-Less 80% < 100 data set.

| FY93-94 Weibull All Data Set | |
|---|---|
| Theta | 545.23 |
| Beta | 1.3208 |
| t | R(t) |
| 50 | 0.9583 |
| 100 | 0.8990 |
| 150 | 0.8337 |
| 200 | 0.7665 |
| 250 | 0.6997 |
| 300 | 0.6349 |
| 350 | 0.5730 |
| 400 | 0.5147 |
| 450 | 0.4602 |
| 500 | 0.4099 |
| 550 | 0.3636 |
| 600 | 0.3215 |
| 650 | 0.2833 |
| 700 | 0.2488 |
| 750 | 0.2179 |
| 800 | 0.1903 |
| 850 | 0.1657 |
| 900 | 0.1439 |
| 950 | 0.1247 |
| 1000 | 0.1077 |
| 1050 | 0.0929 |
| 1100 | 0.0799 |
| 1150 | 0.0686 |
| 1200 | 0.0587 |
| 1250 | 0.0502 |
| 1300 | 0.0428 |
| 1350 | 0.0364 |
| 1400 | 0.0310 |
| 1450 | 0.0263 |
| 1500 | 0.0222 |
| 1550 | 0.0188 |
| 1600 | 0.0158 |
| 1650 | 0.0133 |
| 1700 | 0.0112 |
| 1750 | 0.0094 |
| 1800 | 0.0079 |
| 1850 | 0.0066 |
| 1900 | 0.0055 |
| 1950 | 0.0046 |
| 2000 | 0.0038 |

| FY93-94 Weibull Less 80% < 100 | |
|---|---|
| Theta | 672.93 |
| Beta | 1.7163 |
| t | R(t) |
| 50 | 0.9885 |
| 100 | 0.9628 |
| 150 | 0.9268 |
| 200 | 0.8828 |
| 250 | 0.8329 |
| 300 | 0.7788 |
| 350 | 0.7221 |
| 400 | 0.6640 |
| 450 | 0.6058 |
| 500 | 0.5485 |
| 550 | 0.4929 |
| 600 | 0.4399 |
| 650 | 0.3898 |
| 700 | 0.3430 |
| 750 | 0.2998 |
| 800 | 0.2604 |
| 850 | 0.2247 |
| 900 | 0.1926 |
| 950 | 0.1641 |
| 1000 | 0.1390 |
| 1050 | 0.1170 |
| 1100 | 0.0978 |
| 1150 | 0.0814 |
| 1200 | 0.0673 |
| 1250 | 0.0553 |
| 1300 | 0.0452 |
| 1350 | 0.0368 |
| 1400 | 0.0297 |
| 1450 | 0.0239 |
| 1500 | 0.0191 |
| 1550 | 0.0152 |
| 1600 | 0.0120 |
| 1650 | 0.0095 |
| 1700 | 0.0074 |
| 1750 | 0.0058 |
| 1800 | 0.0045 |
| 1850 | 0.0034 |
| 1900 | 0.0026 |
| 1950 | 0.0020 |
| 2000 | 0.0015 |

**Table 2. Weibull Reliability Calculations**

## F. ANALYSIS OF CANNIBALIZATIONS ON MTBF

### 1. Annual Cannibalizations

In this section a summary is given for the number of engines that were cannibalized (CR) on an annual basis. This can be seen graphically in Figure 3.

**Annual Totals FY90-94**

| Fiscal Year | Annual CR |
|---|---|
| 1990 | 181 |
| 1991 | 142 |
| 1992 | 131 |
| 1993 | 42 |
| 1994 | 67 |

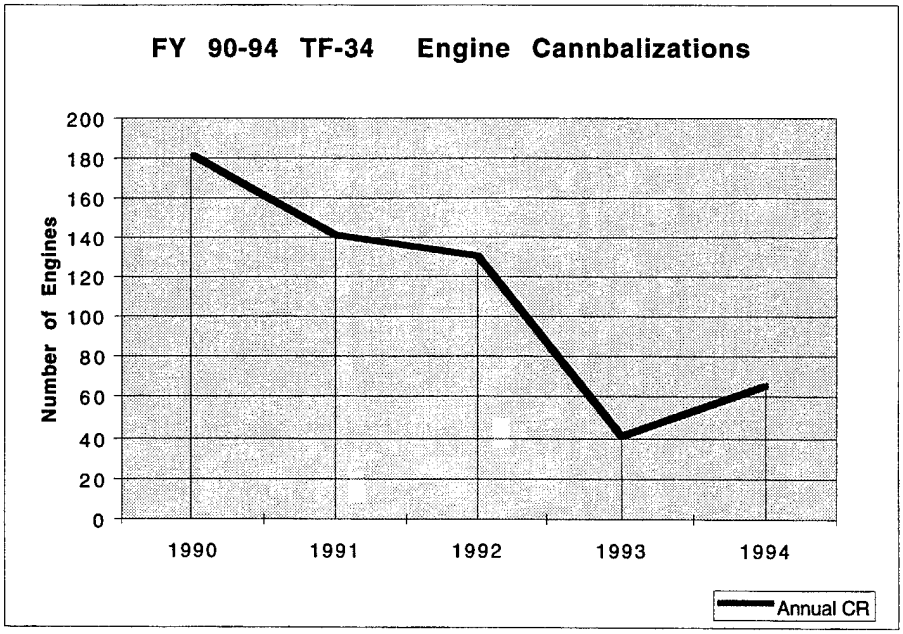



**Figure 3. Annual Cannibalizations**

## 2. Cannibalization Impact on MTBF

Isolating an engine population for a specific failure condition is one of the methodologies used in this thesis. The author has chosen the impact of engine cannibalization reason for engine removal (3W), because these actions represent a large portion of the non-failure time data of the entire TF34 database. The five year database represented by 1812 engine records. Of these records, 563 represent cannibalization engine removals for FY 90-94. The population with the next largest non-failure times are for engines removed for high-time components which will be discussed in detail in Chapter IV.

### *a. Procedure for Establishing Cannibalization Impact on MTBF*

Caudill's thesis [Ref. 2] produced a database to analyze the impact of cannibalization actions on MTBF of the TF34 engine. For each cannibalization that was followed by a failure he computed the number of flight hours before that failure occurred. He made these computations for the entire five year database. This established a database of cannibalization engine failures. Caudill's thesis established that cannibalization actions have an adverse impact on the TF34 engine MTBF with respect to the entire five year database. To analyze whether cannibalization actions have had less adverse impact on engine failure times in the most recent years, the five year database was divided into the five individual fiscal years and statistical analyses were conducted on each year to determine the mean, standard deviation, and the median of these failure times. The results are presented in Table 3. A graphical representation of these results are presented in Figure 4.

| *Statistic FY90* | Cannibalization Followed By Engine Failure | Failure Data Comparison Table 1, All Category |
|---|---|---|
| # of Engines | 33 | |
| Max (Flt Hrs) | 830 | |
| Min (Flt Hrs) | 0 | |
| **MTBF(FLt Hrs)** | **116** | **399** |
| Std Dev (Flt Hrs) | 190 | 399 |
| Median (FLt Hrs) | 32 | |

| *Statistic FY91* | Cannibalization Followed By Engine Failure | Failure Data Comparison Table 1, All Category |
|---|---|---|
| # of Engines | 36 | |
| Max (Flt Hrs) | 1018 | |
| Min (Flt Hrs) | 0 | |
| **MTBF(FLt Hrs)** | **251** | **518** |
| Std Dev (Flt Hrs) | 222 | 413 |
| Median (FLt Hrs) | 253 | |

| *Statistic FY92* | Cannibalization Followed By Engine Failure | Failure Data Comparison Table 1, All Category |
|---|---|---|
| # of Engines | 42 | |
| Max (Flt Hrs) | 1140 | |
| Min (Flt Hrs) | 0 | |
| **MTBF(FLt Hrs)** | **304** | **509** |
| Std Dev (Flt Hrs) | 302 | 392 |
| Median (FLt Hrs) | 252 | |

| *Statistic FY93* | Cannibalization Followed By Engine Failure | Failure Data Comparison Table 1, All Category |
|---|---|---|
| # of Engines | 45 | |
| Max (Flt Hrs) | 1099 | |
| Min (Flt Hrs) | 0 | |
| **MTBF(FLt Hrs)** | **302** | **494** |
| Std Dev (Flt Hrs) | 311 | 370 |
| Median (FLt Hrs) | 187 | |

| *Statistic FY94* | Cannibalization Followed By Engine Failure | Failure Data Comparison Table 1, All Category |
|---|---|---|
| # of Engines | 17 | |
| Max (Flt Hrs) | 986 | |
| Min (Flt Hrs) | 0 | |
| **MTBF(FLt Hrs)** | **215** | **512** |
| Std Dev (Flt Hrs) | 302 | 399 |
| Median (FLt Hrs) | 120 | |

**Table 3. Cannibalization MTBF**

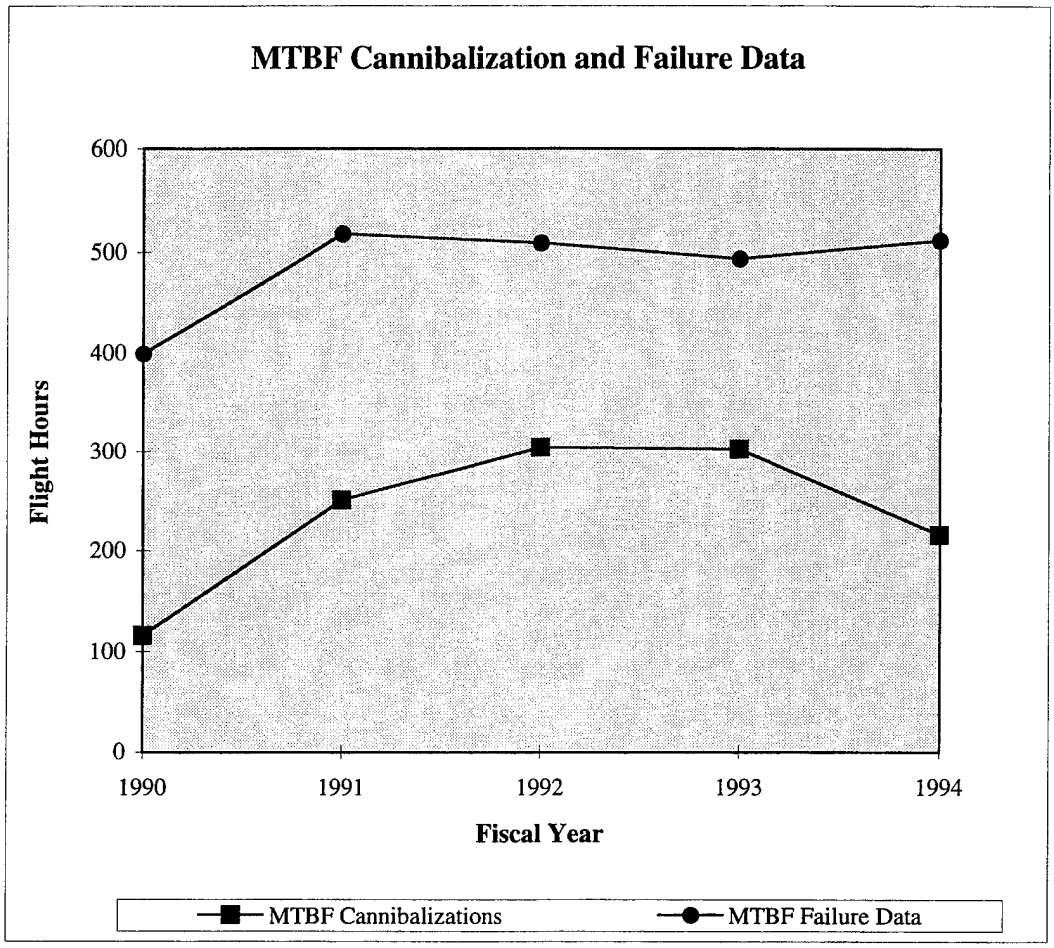



**Figure 4. MTBF for Cannibalization Data and All Failure Data**

### *b. Does Engine Cannibalization Have Less Adverse Impact on TF34 MTBF in the Most Recent Years?*

The results of the analysis given in Table 3 indicate that the MTBF for engines that were cannibalized then followed by a failure did improve in 1991 and 1992, but appears to have declined in 1994.

## 3. New Engine Purchase Fiscal Year 1992

During the FY92, 50 new TF34 engines were purchased to alleviate engine and spare part shortages. [ Ref. 6] This purchase had a dramatic effect on the number of engines that were cannibalized in the following years, see Figure 3 Section F of this chapter. However, the purchase of 50 new TF34 engines did not appear to have a significant impact on MTBF on engines that were cannibalized then followed by a failure. The data also indicated no appreciable effect on MTBF for the engine failure database which remained relatively constant for the following years.

# III. IS MTBF A FUNCTION OF THE NUMBER OF PREVIOUS REPAIRS?

## A. THE TRUE FAILURE DATA SET

To answer the question as to whether the MTBF of an engine depends on the number of previous repairs, the data set, actual engine failures described in Chapter II, Section A, was sorted to produce a new data set that had no zero FHSR entries in the database. The initial data set consisted of 697 records with 38 of these records having a zero FHSR entry. These zero entries were deleted to enable the data set to represent true failure times after "t" operating hours. This data set shall be referred to as the True Failure data set.

### 1. Failure Time Categories

The data was first sorted by engine serial number and start date (engine removal date). This resulted in a chronological removal history for each engine serial number in the data set, see Appendix C. To distinguish whether an engine was on its first, second, third, or fourth successive repair, the chronological engine records were coded 1, 2, 3, 4 respectively. This coding now enabled the data to be sorted into categories labeled First, Second, Third, and Fourth time removed for repair since FY90. The First category FHSR records were truncated at 1500 hours resulting with 328 records for this category. Each category could now be analyzed with previous methods, Non-Parametric and Weibull Distribution analysis. The resulting parameters are presented in Table 4.

**FIRST REPAIR**

| FY90-94 TF | # of records | BETA | THETA | MTBR | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 328 | 1.7536 | 705.91 | 628.60 | 369.88 |
| Nonpara - All | 328 | | | 609.68 | 406.48 |
| Weibull - less 10% | 295 | 2.022 | 774.04 | 685.76 | 358.99 |
| Nonpara - less 10% | 295 | | | 672.69 | 379.57 |
| Weibull - less 50% <100 | 312 | 1.8791 | 739.04 | 655.95 | 361.36 |
| Nonpara - less 50% <100 | 312 | | | 639.95 | 393.54 |
| Weibull - less 80% <100 | 302 | 1.9619 | 759.66 | 673.50 | 358.39 |
| Nonpara - less 80% <100 | 302 | | | 659.14 | 385.34 |

**SECOND REPAIR**

| FY90-94 TF | # of records | BETA | THETA | MTBR | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 213 | 1.083 | 397.34 | 384.93 | 357.79 |
| Nonpara - All | 213 | | | 383.26 | 362.63 |
| Weibull - less 10% | 192 | 1.2479 | 460.55 | 428.95 | 345.31 |
| Nonpara - less 10% | 192 | | | 424.67 | 358.43 |
| Weibull - less 50% <100 | 181 | 1.3435 | 494.66 | 453.30 | 342.82 |
| Nonpara - less 50% <100 | 181 | | | 449.18 | 354.66 |
| Weibull - less 80% <100 | 161 | 1.5391 | 558.89 | 503.07 | 333.70 |
| Nonpara - less 80% <100 | 161 | | | 498.86 | 344.99 |

**THIRD REPAIR**

| FY90-94 TF | # of records | BETA | THETA | MTBR | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 86 | 1.1937 | 353.76 | 333.45 | 281.21 |
| Nonpara - All | 86 | | | 330.40 | 288.14 |
| Weibull - less 10% | 77 | 1.3606 | 404.05 | 369.57 | 275.61 |
| Nonpara - less 10% | 77 | | | 368.10 | 281.23 |
| Weibull - less 50% <100 | 74 | 1.4192 | 421.02 | 382.56 | 274.38 |
| Nonpara - less 50% <100 | 74 | | | 381.86 | 278.22 |
| Weibull - less 80% <100 | 68 | 1.5405 | 455.24 | 409.77 | 271.81 |
| Nonpara - less 80% <100 | 68 | | | 410.62 | 272.01 |

**FOURTH REPAIR**

| FY90-94 TF | # of records | BETA | THETA | MTBR | STD DEV |
|---|---|---|---|---|---|
| Weibull - All | 22 | 1.0402 | 345.66 | 340.04 | 326.52 |
| Nonpara - All | 22 | | | 339.18 | 331.13 |
| Weibull - less 10% | 20 | 1.2068 | 401.48 | 377.27 | 314.53 |
| Nonpara - less 10% | 20 | | | 372.85 | 328.73 |
| Weibull - less 50% <100 | 18 | 1.3994 | 458.99 | 417.94 | 303.73 |
| Nonpara - less 50% <100 | 18 | | | 412.61 | 322.54 |
| Weibull - less 80% <100 | 16 | 1.6304 | 518.94 | 464.28 | 293.45 |
| Nonpara - less 80% <100 | 16 | | | 460.75 | 309.26 |

**Table 4. Non-Parametric and Weibull Distribution Parameters**

## 2. Cumulative Distribution Functions of the True Failure Data

Table 4 represents both the Non-Parametric and Weibull parameters, MTBF and associated values for the True Failure data set. These categories are similar to Table 1 in Chapter II. However, there is no "less-zero" category because all zero records were deleted. The values beta, theta, MTBF, and Standard Deviation (STD DEV) were computed as described in Chapter II.

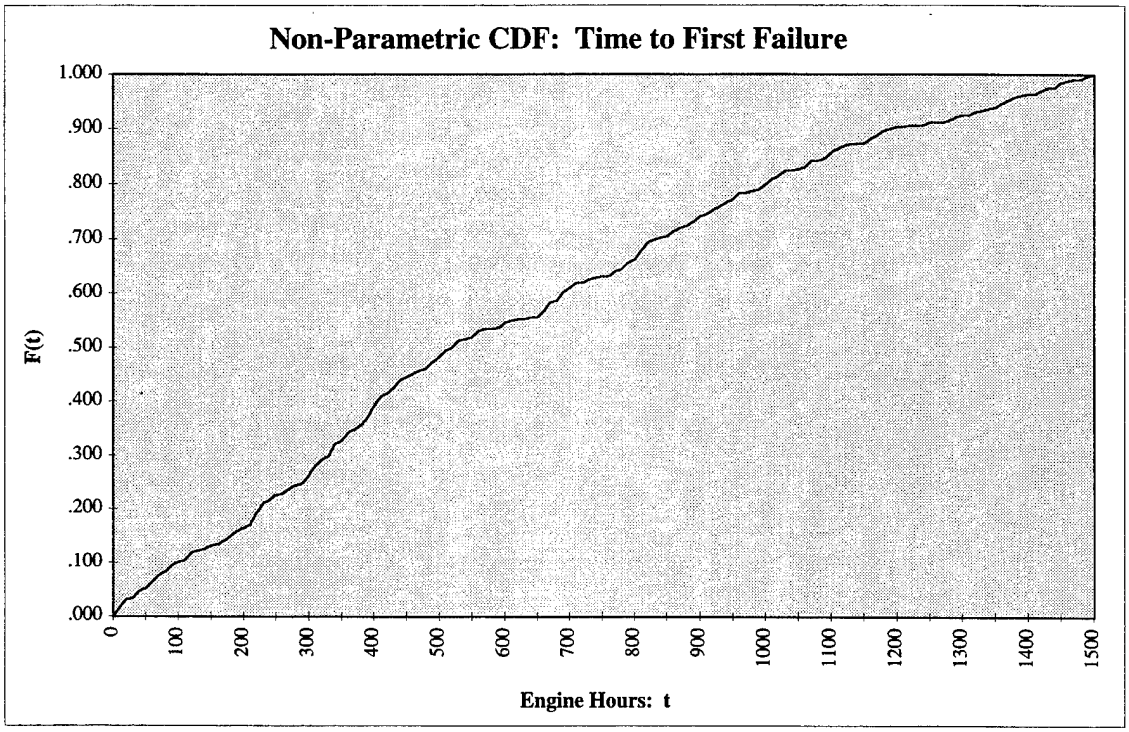
There is a significant difference between the first repair MTBF and all subsequent repair MTBFs. The engines making their first shop visit for repair have an MTBF of 628 hours (Weibull-All Table 4). By comparison, the subsequent shop visits display a significantly reduced MTBF, namely the Second data set has a MTBF of 385 hours, the Third data set has a MTBF of 333 hours, and the Fourth data set has a MTBF of 340 hours for the same "All" category. This is an indication of a minimum repair being accomplished. For example, an engine removed for a high time High Pressure Turbine (HPT) will be inducted to the Intermediate Maintenance Activity (IMA) and receive a Major Engine Inspection (MEI). All engines upon induction to the IMA are required to have a MEI. In this inspection, an engine undergoes a visual inspection including a borescope inspection of the entire engine.[1] This inspection could reveal cracks in the combustor that are not out of limits in accordance with the Maintenance Instruction Manuals (MIMs). Consequently, these cracks are only close to rejection and the combustor is not repaired. The high-time component, the HPT, which is the original engine discrepancy, is removed and replaced and the engine is returned to service. The HPT now has 1500 operating hours remaining and the combustor cracks may have only 500 hours remaining. Hypothetically, the engine will return to the IMA when the combustor fails. It is interesting to note that the MTBFs of

[1] A borescope inspection is where the technicians inspect the internal areas of the engine. A borescope is a fiberoptic instrument that can be inserted through a small access and allow the inspector to view inside the engine without disassembly.

the second, third and fourth consecutive repairs remain close to the IMA no-build time of 350 hours. Figure 5 graphically compares the Non-Parametric Cumulative Distribution Function (CDF) and the Weibull CDF of the individual data sets First, Second, Third, and Fourth.

### 3. Comparison of Analysis Methods

The Non-Parametric and the Weibull fit reveal some inconsistencies with the First data set. The remaining data sets display a relatively good fit to the respective data. The First data set requires more information and analysis to determine a more accurate fit of a probability distribution to the population of engines.



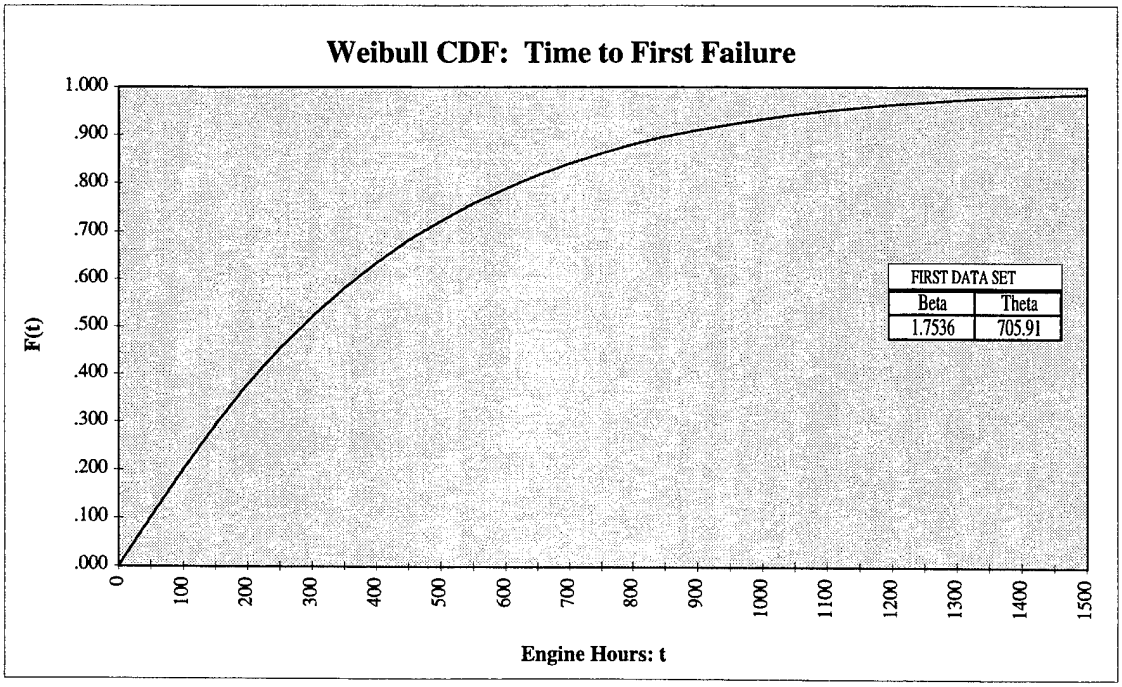
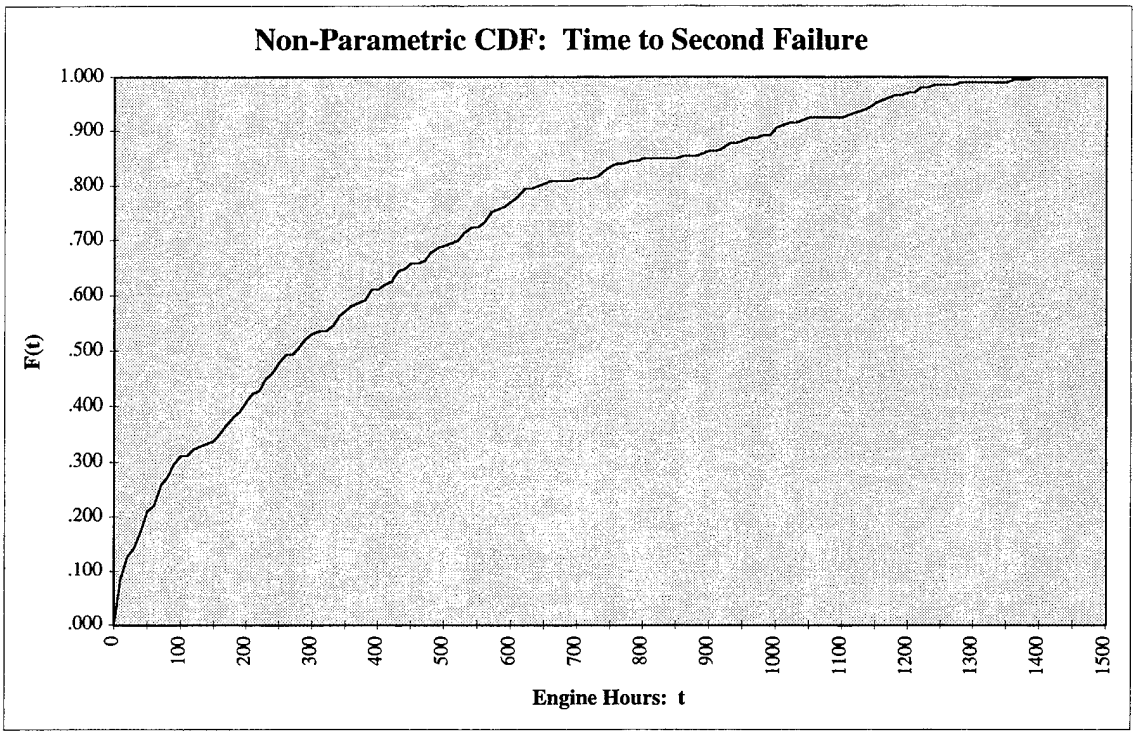




**Figure 5. CDF of the True Failure Data Sets**



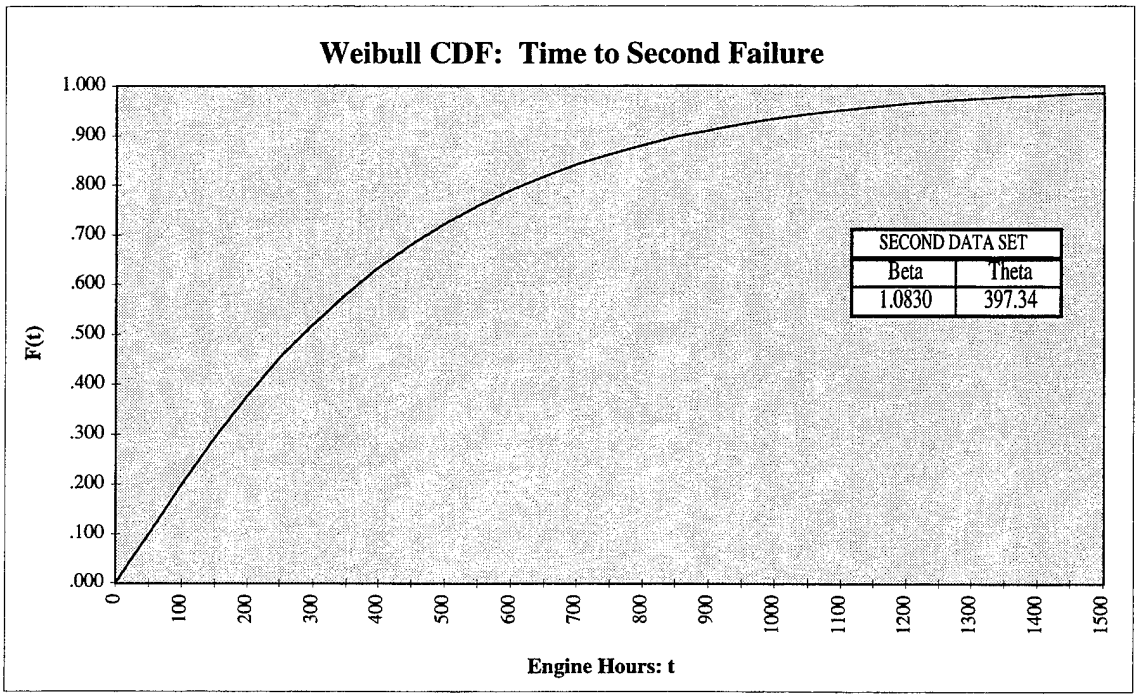
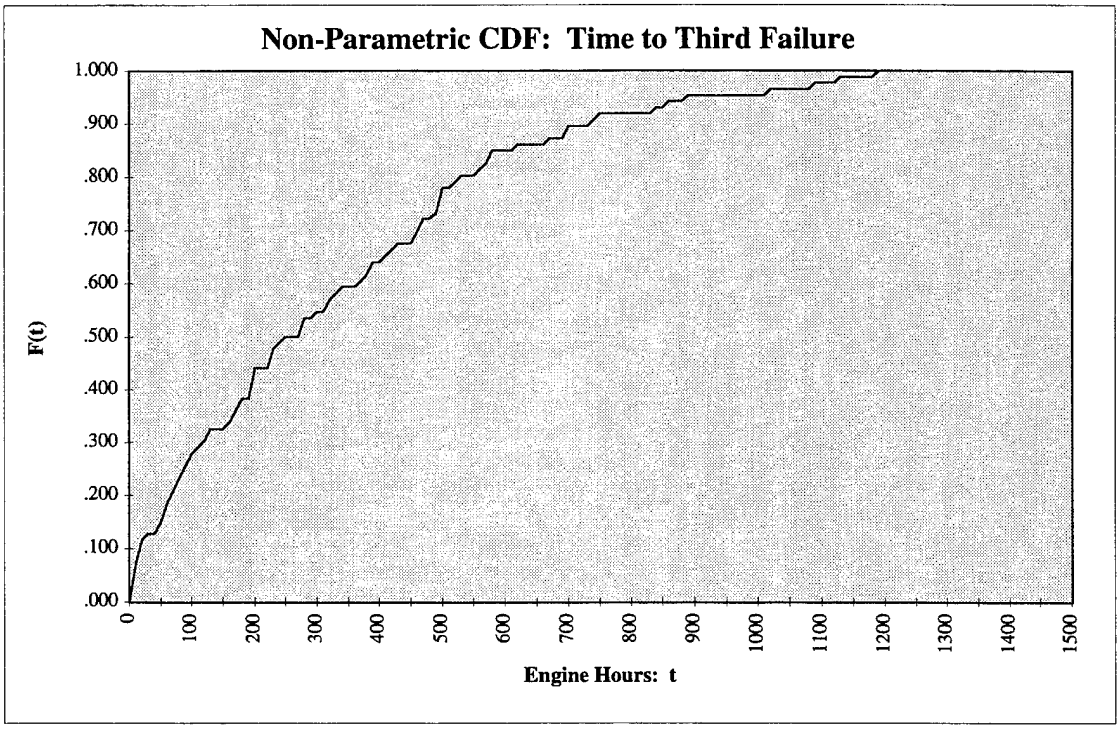




**Figure 5. CDF of the True Failure Data Sets**



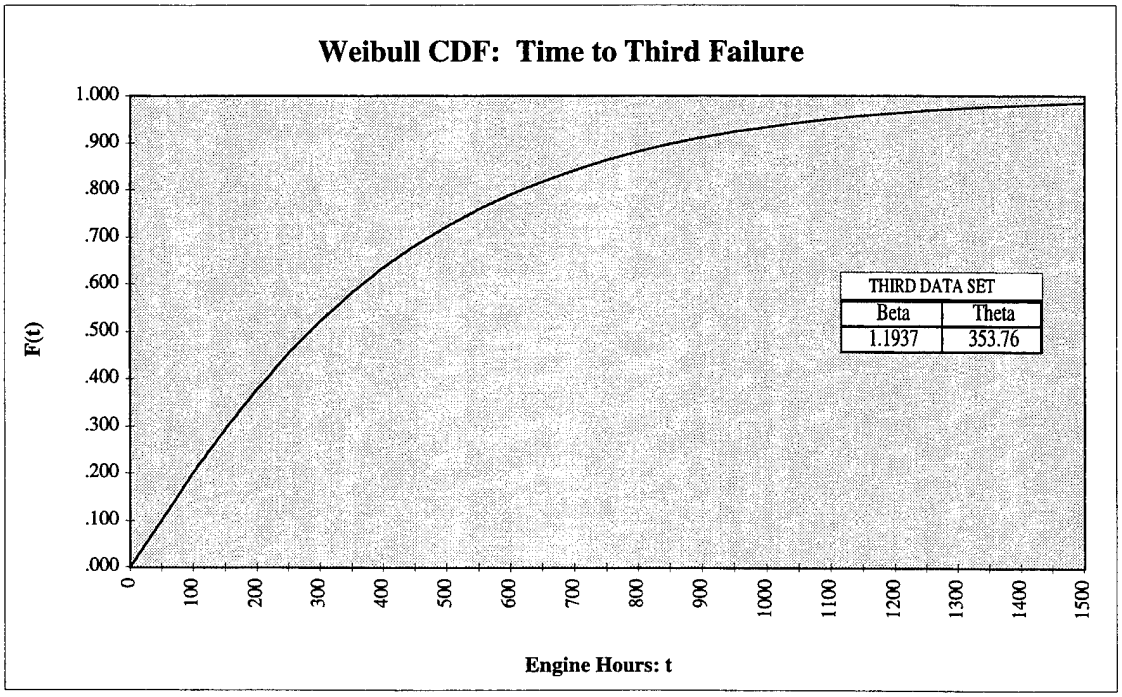
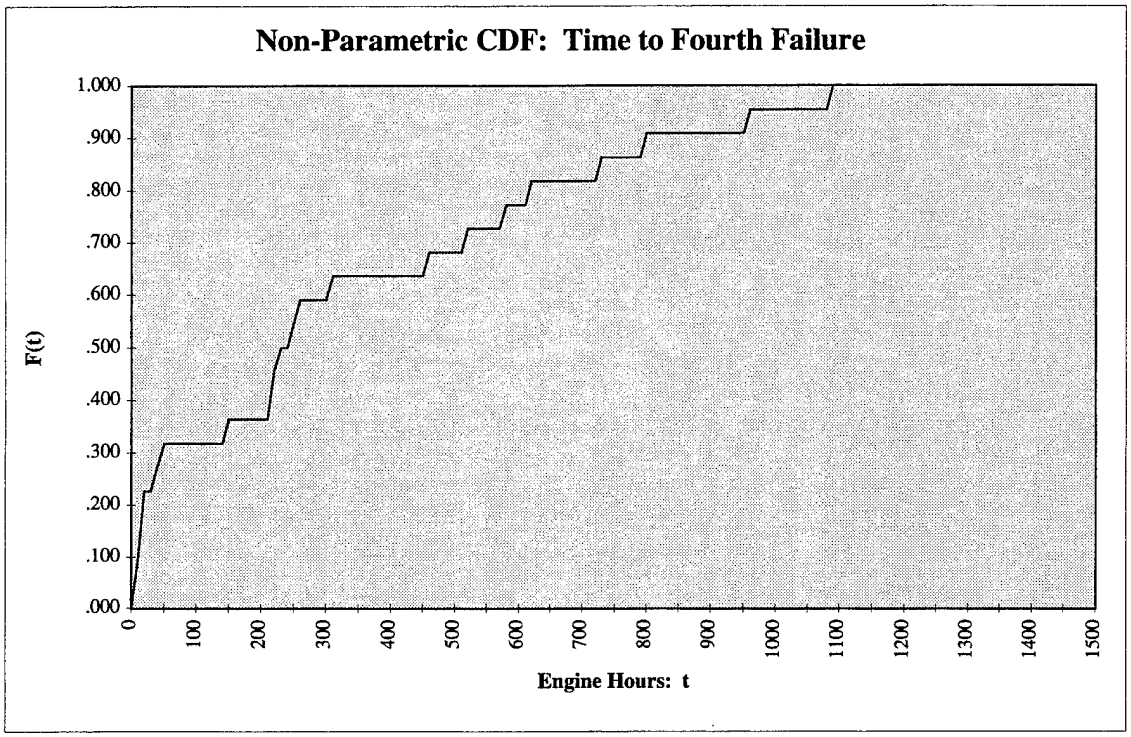




**Figure 5. CDF of the True Failure Data Sets**



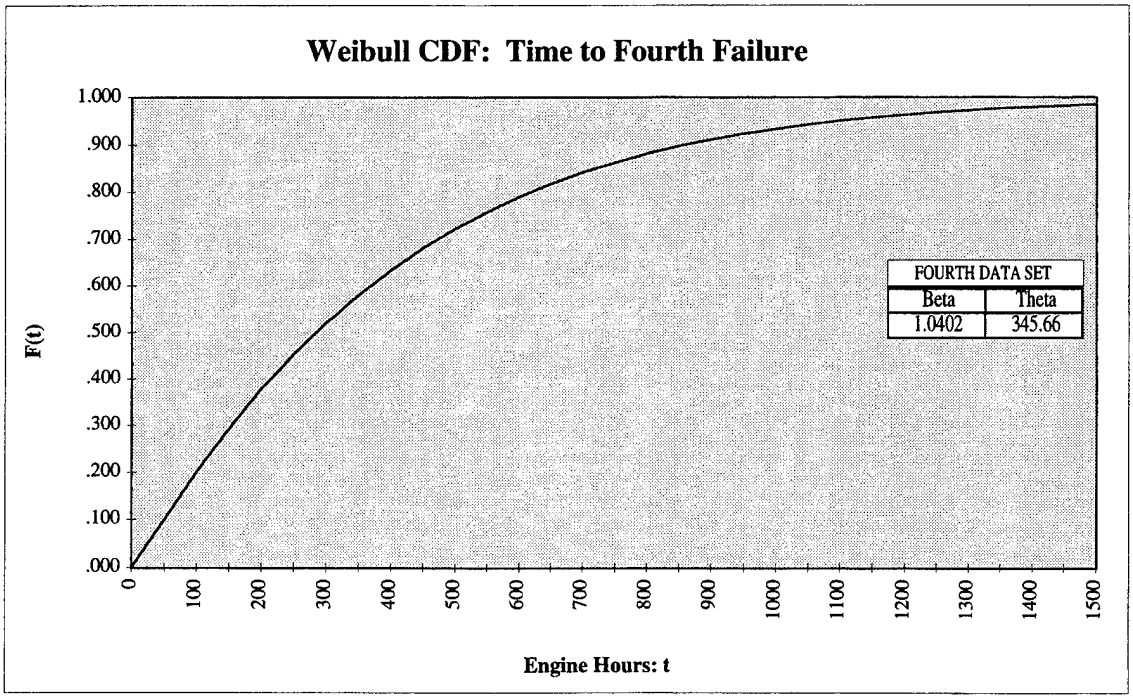




**Figure 5. CDF of the True Failure Data Sets**

### 4. The Probability Density Function of the True Failure Data

Section D of Chapter II explained the Weibull distribution and how it is characterized by two parameters, $\theta$ and $\beta$. If $\beta = 1$, then the Weibull distribution is an Exponential distribution.

The Weibull PDF values have been computed for the First, Second, Third and Fourth repair data sets with respect to their theta and beta parameters and are presented in Table 5 followed by a graphical representation in Figure 6. It is evident that the First data set represents a different distribution than the Second, Third or the Fourth data sets. The distribution of the First data set more closely resembles a Weibull distribution. The Second through Fourth data sets more closely represent an Exponential distribution.

| Failure t | FIRST Repair | SECOND Repair | THIRD Repair | FOURTH Repair |
|---|---|---|---|---|
| 50 | 0.00033 | 0.00206 | 0.00210 | 0.00244 |
| 100 | 0.00055 | 0.00194 | 0.00212 | 0.00217 |
| 150 | 0.00072 | 0.00177 | 0.00200 | 0.00191 |
| 200 | 0.00086 | 0.00160 | 0.00182 | 0.00167 |
| 250 | 0.00097 | 0.00143 | 0.00163 | 0.00145 |
| 300 | 0.00104 | 0.00127 | 0.00144 | 0.00126 |
| 350 | 0.00109 | 0.00113 | 0.00125 | 0.00109 |
| 400 | 0.00112 | 0.00100 | 0.00109 | 0.00095 |
| 450 | 0.00112 | 0.00088 | 0.00093 | 0.00082 |
| 500 | 0.00111 | 0.00077 | 0.00080 | 0.00070 |
| 550 | 0.00108 | 0.00068 | 0.00068 | 0.00061 |
| 600 | 0.00104 | 0.00059 | 0.00057 | 0.00052 |
| 650 | 0.00098 | 0.00052 | 0.00048 | 0.00045 |
| 700 | 0.00092 | 0.00045 | 0.00040 | 0.00039 |
| 750 | 0.00086 | 0.00039 | 0.00034 | 0.00033 |
| 800 | 0.00079 | 0.00034 | 0.00028 | 0.00028 |
| 850 | 0.00072 | 0.00030 | 0.00023 | 0.00024 |
| 900 | 0.00065 | 0.00026 | 0.00019 | 0.00021 |
| 950 | 0.00058 | 0.00022 | 0.00016 | 0.00018 |
| 1000 | 0.00051 | 0.00019 | 0.00013 | 0.00015 |
| 1050 | 0.00045 | 0.00017 | 0.00011 | 0.00013 |
| 1100 | 0.00039 | 0.00015 | 0.00009 | 0.00011 |
| 1150 | 0.00034 | 0.00013 | 0.00007 | 0.00010 |
| 1200 | 0.00029 | 0.00011 | 0.00006 | 0.00008 |
| 1250 | 0.00025 | 0.00009 | 0.00005 | 0.00007 |
| 1300 | 0.00021 | 0.00008 | 0.00004 | 0.00006 |
| 1350 | 0.00018 | 0.00007 | 0.00003 | 0.00005 |
| 1400 | 0.00015 | 0.00006 | 0.00003 | 0.00004 |
| 1450 | 0.00012 | 0.00005 | 0.00002 | 0.00004 |
| 1500 | 0.00010 | 0.00004 | 0.00002 | 0.00003 |
| 1550 | 0.00008 | 0.00004 | 0.00001 | 0.00003 |
| 1600 | 0.00007 | 0.00003 | 0.00001 | 0.00002 |
| 1650 | 0.00006 | 0.00003 | 0.00001 | 0.00002 |
| 1700 | 0.00005 | 0.00002 | 0.00001 | 0.00002 |
| 1750 | 0.00004 | 0.00002 | 0.00001 | 0.00001 |
| 1800 | 0.00003 | 0.00002 | 0.00000 | 0.00001 |
| 1850 | 0.00002 | 0.00002 | 0.00000 | 0.00001 |
| 1900 | 0.00002 | 0.00001 | 0.00000 | 0.00001 |
| 1950 | 0.00001 | 0.00001 | 0.00000 | 0.00001 |
| 2000 | 0.00001 | 0.00001 | 0.00000 | 0.00001 |

**True Failure Data Set**

| | Beta | Theta |
|---|---|---|
| FIRST | 1.7536 | 705.91 |
| SECOND | 1.0830 | 397.34 |
| THIRD | 1.1937 | 353.76 |
| FOURTH | 1.0402 | 345.66 |

**Table 5. Weibull PDF of True Failure Data Set**

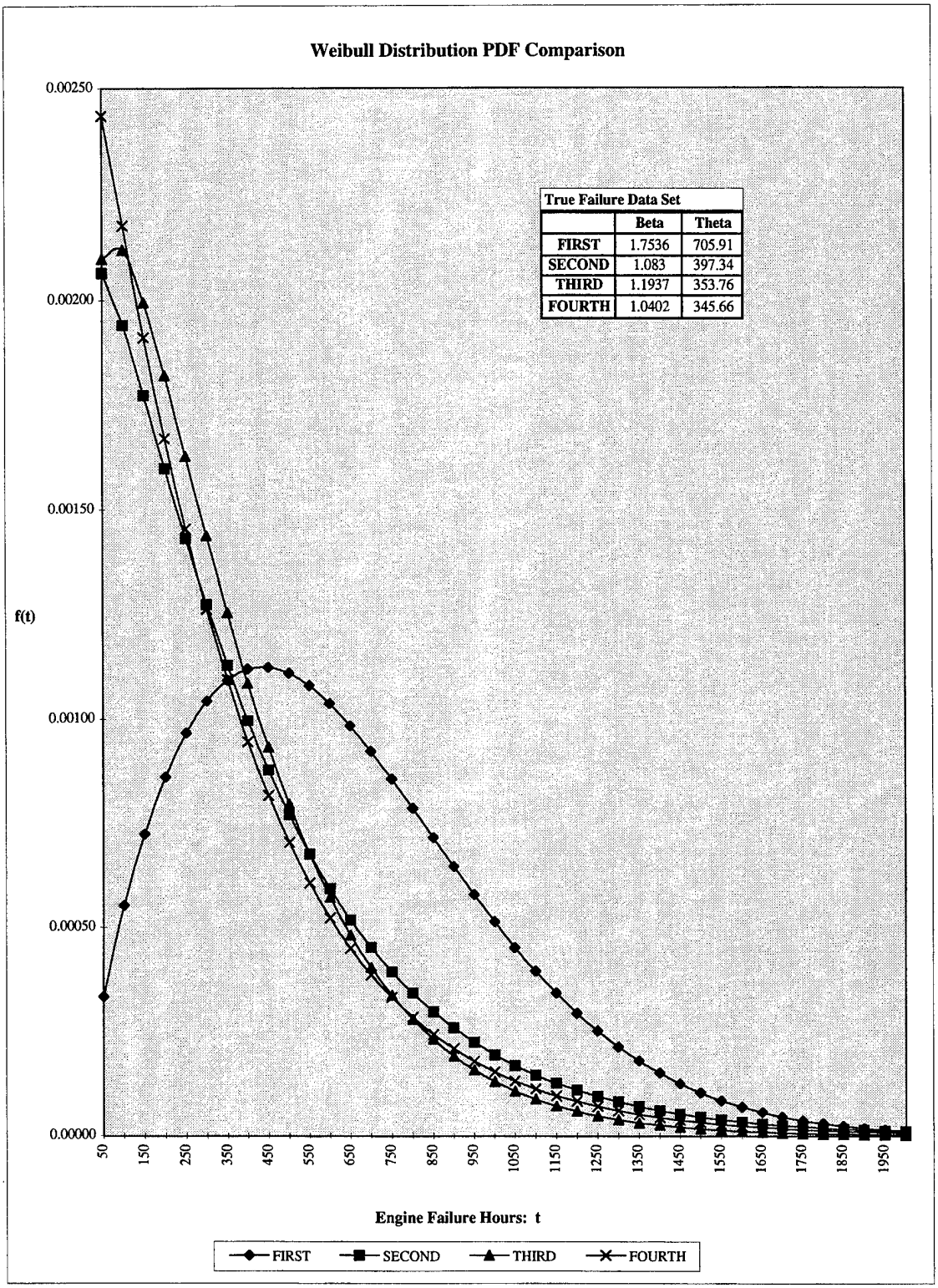



**Figure 6. Weibull Distribution PDF**

# IV. SETTING INSPECTION TIMES AND NO-BUILD TIMES

## A. ENGINE INSPECTION TIMES

### 1. Life Limited Components

A significant factor impacting scheduled maintenance of a TF34 engine is that many of the components have designated limited operating times (high-times). When these components reach their high-times, they must be inspected or replaced. These components are also known as high-time components. The TF34 engine system has five major subsystems. They are the Fan Rotor, Compressor Rotor, Combustor, High Pressure Turbine (HPT) Rotor, and the Low Pressure Turbine (LPT) Rotor. Each subsystem is made up of numerous subassemblies, such as, turbine blade sets, cooling plates and turbine disks. One of the largest challenges in building TF34 engines from spare components in the maintenance process, is to select the combination of different components that will result in longest life before next engine removal. A listing of TF34 engine subsystems and subassemblies is provided in Table 6. [Ref. 8] Selecting a combination of components to build an engine during maintenance is further complicated by the fact that many of the components have several versions (different part numbers) of the same replacement part, all having a different life limit.

| NOMENCLATURE | PART NUMBER | DISPOSITION | OPERATING HOURS |
|---|---|---|---|
| **FAN ROTOR** | **ALL** | Repair at Depot | |
| Fan Disk | 6020T62G02 | Scrap at Depot | 3300 see note 3 |
| Fan Disk | 6020T62G03/04/05 | Repair at Depot | 4750 see note 3 |
| Fan Disk | 6016T32G03/05 | Scrap at Depot | 3300 see note 3 |
| Fan Disk | 5920T88G03/04/06/07 | Scrap at Depot | 3300 see note 3 |
| Fan Disk | 5920T88G02/05 | Repair at Depot | 4750 see note 3 |
| Fan Disk | 5921T18G01/02/03/0 /10 | Scrap at Depot | 4500 TSR see note 3 |
| Fan Disk | 6078T00G01 | Repair at Depot | 4750 see note 3 |
| Fan Drive Shaft | 6019T44P02GSI/P03GSI | Scrap at Depot | 7800 see note 3 |
| Fan Drive Shaft | 6019T44P02/P03 | Insp. at Depot | 4500 see note 3 |
| Fan Drive Shaft | 6030T54G01GSI | Scrap at Depot | 7800 see note 3 |
| Fan Drive Shaft | 6030T54G01 | Insp. at Depot | 4500 see note 3 |
| Fan Drive Shaft | 6036T78P02 | Scrap at Depot | 13700 see note 3 |
| Fan Blade | 6018T30P02/03 | Scrap at Depot | 4800 see note 3 |
| Fan Forward Shaft | 6017T63P01/03/04 | Scrap at Depot | 15000 see note 3 |
| **COMPRESSOR ROTOR** | **ALL** | Repair at Depot | see note 2 |
| Forward Shaft | 5037T01P02 | Scrap at Depot | 15000 see note 3 |
| Stage 1 Disk | 6017T54P02/03 | Scrap at Depot | 8000 see note 3 |
| Stage 1 Disk | 5920T44P02 | Scrap at Depot | 8000 see note 3 |
| Stage 1 Disk | 6037T01P01 | Scrap at Depot | 7000 see note 3 |
| Stage 2 Disk | 6017T66P01/03 | Scrap at Depot | 8000 see note 3 |
| Stage 2 Disk | 5920T81P01 | Scrap at Depot | 7000 see note 3 |
| Stage 2 Disk | 6036T91P01 | Scrap at Depot | 7000 see note 3 |
| Stage 3 - 8 Spool | **ALL** | Scrap at Depot | 12300 see note 3 |
| Stage 9 Disk | 6016T43P03 | Scrap at Depot | 12000 see note 3 |
| Stage 10 - 14 Spool | 6020T65P01/P02 | Scrap at Depot | 7100 see note 3 |
| Rear Shaft | 6016T83P01 | Scrap at Depot | 9000 see note 3 |
| Rotating Seal | 4019T38P01 | Scrap at Depot | 15000 see note 3 |
| **COMBUSTOR** | **ALL** | | |
| Combustion Chamber Frame | 6021T72G03 | Scrap at Depot | 7500 ** see note 1 |
| Combustion Chamber Frame | 5038T17G01 | Scrap at Depot | 7500 ** see note 1 |
| Combustion Chamber Frame | 6021T72G06/10 | Scrap at Depot | 7500 ** see note 1 |
| Combustion Chamber Frame | 5920T97G01 thru 05 | Scrap at Depot | 7500 ** see note 1 |

** fluropenetrant inspection required at 1500 hour intervals, thereafter

**NOTES:**

1. Inspection required at 1500 hour intervals. Scrap on condition.
2. Removal interval based on lowest life remaining part in assembly.
3. No extension allowed.
4. Life limit anticipated greater than 15,000 hours.

**Table 6. Life Limits**

| NOMENCLATURE | PART NUMBER | DISPOSITION | OPERATING HOURS |
|---|---|---|---|
| **HPT ROTOR** | **ALL** | Repair at Depot | see note 2 |
| Forward Shaft | 6017T00P03 | Scrap at Depot | 15000 see note 3 |
| Balance Rotating Piston Seal | 5025T33P03/04 | Scrap at Depot | 12000 see note 3 |
| Stg. 1 Fwd Cooling Plate | 4027T15P02 | Scrap at Depot | 9000 |
| Stage 1 Turbine Disk | 6031T89P02 | Scrap at Depot | 12000 see note 3 |
| Stage 1 Turbine Disk | 3921T50P01 | Scrap at Depot | 12000 see note 3 |
| Stage 1 Turbine Disk | 6031T89P01 | Scrap at Depot | 9870 see note 3 |
| Stage 1 Turbine Disk | 5025T23P01 | Scrap at Depot | 4500 see note 3 |
| Stg. 1 Turbine Blade | 6016T19PO4 | Scrap at Depot | 1500 |
| Stg. 1 Turbine Blade | 6016T20G05 | Scrap at Depot | 1500 |
| Stg. 1 Turbine Blade | 6040T44G14 | Scrap at Depot | 3000 |
| Stg. 1 Aft Cooling Plate | 5025T95P01, /A | Scrap at Depot | 1500 |
| Stg. 1 Aft Cooling Plate | 5041T70P01, /A | Scrap at Depot | 4500 |
| Stg. 1 Aft Cooling Plate | 5041T70P03, /A | Scrap at Depot | 15000 |
| Torque Coupling - Pancake | 5026T11P02 | Scrap at Depot | 1500 |
| Torque Coupling - Contour | 5026T11P02 | Scrap at Depot | 3200 |
| Torque Coupling | 4021T18P03 | Scrap at Depot | 1500 see note 3 |
| Inner Torque Coupling | 5041T66P02 | Scrap at Depot | 8000 see note 3 |
| Outer Torque Coupling | 5041T67P02 | Scrap at Depot | 13000 |
| Stg. 2 Fwd. Cooling Plate | 5021T77P01, /A | Scrap at Depot | 1500 see note 3 |
| Stg. 2 Fwd. Cooling Plate | 5042T29P01, /A | Scrap at Depot | 13000 |
| Stg. 2 Fwd. Cooling Plate | 3921T53P01A | Scrap at Depot | 13000 |
| Stg. 2 Fwd. Cooling Plate | 3921T57P01 | Scrap at Depot | 1500 see note 3 |
| Stg. 2 Fwd. Cooling Plate | 3921T57P01A | Scrap at Depot | 1500 see note 3 |
| Stg. 2 Turbine Disk | 6031T90P01 | Scrap at Depot | 5800 |
| Stg. 2 Turbine Disk | 6031T90P02 | Scrap at Depot | 8000 see note 3 |
| Stg. 2 Turbine Disk | 3921T51P01 | Scrap at Depot | 8000 see note 3 |
| Stg. 2 Turbine Disk | 5026T10P01 | Scrap at Depot | 4500 see note 3 |
| Stg. 2 Aft Cooling Plate | 5023T97P02 | Scrap at Depot | 9000 see note 3 |
| Stg. 2 Aft Cooling Plate | 3921T54P01 | Scrap at Depot | 9000 see note 3 see note 2 |

** fluropenetrant inspection required at 1500 hour intervals, thereafter

**NOTES**:

1. Inspection required at 1500 hour intervals. Scrap on condition.
2. Removal interval based on lowest life remaining part in assembly.
3. No extension allowed.
4. Life limit anticipated greater than 15,000 hours.

**Table 6. Life Limits (continued)**

| | PART NUMBER | DISPOSITION | OPERATING HOURS |
|---|---|---|---|
| **LPT ROTOR** | 5026T20G03/05 | Repair at Depot | |
| Drive Cone | 5023T40P01 | Scrap at Depot | 15000 |
| Stg. 3 Turbine Disk | 3920T56P01 | Scrap at Depot | 6100 |
| Stg. 3 Turbine Disk | 5026T16P01/02 | Scrap at Depot | 15000 |
| Stage 3 - 4 Seal | 5023T59P02 | Scrap at Depot | 15000 |
| Stage 3 - 4 Seal | 5023T59P03 | Scrap at Depot | 8900 |
| Stage 4 Turbine Disk | 5023T42P02/03 | Scrap at Depot | 4500 |
| Stage 4 Turbine Disk | 5026T17P02/03 | Scrap at Depot | 6000 see note 3 |
| Stage 4 - 5 Seal | 5038T56P01 | Scrap at Depot | 15000 |
| Stage 4 - 5 Seal | 5023T67P01 | Scrap at Depot | 15000 |
| Stage 5 Turbine Disk | 5024T53P01/02 | Scrap at Depot | 15000 |
| Stage 5 - 6 Seal | 5023T64P02 | Scrap at Depot | 15000 |
| Stage 6 Turbine Disk | 5023T45P03/04 | Scrap at Depot | 15000 |
| Stage 6 Turbine Disk | 3290T57P01 | Scrap at Depot | 15000 |
| Rear Shaft | 6030T72P02 | Scrap at Depot | 15000 |

** fluropenetrant inspection required at 1500 hour intervals, thereafter

**NOTES**:

1. Inspection required at 1500 hour intervals. Scrap on condition.
2. Removal interval based on lowest life remaining part in assembly.
3. No extension allowed.
4. Life limit anticipated greater than 15,000 hours.

**Table 6. Life Limits (continued)**

### 2. No-Build Times and Hard Inspection Times

The technicians at the IMA and the Depot have certain criteria that constrains the assembly of an engine. At the IMA, an engine will not be assembled if the combination of available components to build it result in an engine whose remaining operating time before next scheduled removal is less than 350 hours. At the Depot, an engine will not be assembled if the combination of available components would yield an engine whose operating time before next scheduled removal is less than 500 hours. [Ref. 8] These constraining time values are commonly known as no-build times among maintenance personnel. Table 6 lists several notes that further complicate this matter. Note 1 pertains solely to the Combustor. It states that the Combustor must be inspected every 1500 hours. Moreover, the Combustor must have a fluropenatrant inspection at every 1500 hour interval. Along with the HPT, the maximum operating time any engine stays on an aircraft wing is 1500 hours. In a Reliability Centered Maintenance Program, these items are called hard build times, the field activities try to manage all Life Limited components and assemble engines with the goal of maximizing operating hours. The primary purpose of this chapter is to present a methodology for computing no-build time of a Significant Item (SI) given its Hard Time (HT) and maintenance cost factors.

## B. RELIABILITY CENTERED MAINTENANCE (RCM)

Reliability Centered Maintenance is a formal methodology used to identify what preventative maintenance tasks should be done and when they should be done in order to obtain the inherent reliability of equipment at the least expenditure of resources. [Ref. 9: p. ii] One major function in an RCM program is to identify Significant Items that should have hard inspection times called Hard Times.

### 1. Significant Item Determination

A function performed early in RCM is the determination of Significant Items (SI). These items are subsystems or subassemblies. SI items are identified by performing a Failure, Mode, Effects and Criticality Analysis. [Ref. 9]

### 2. Setting Hard Inspection Times

A hard inspection time for an SI item is the scheduled removal of all units of the item before some specified maximum age limit, to prevent functional failure. [Ref. 9: p. 4-8] The Defense Technical Information Center, Defense Logistics Agency, Technical Report [Ref. 10] and the Naval Air Systems Command, "RCM ANALYSTS COURSE," [Ref. 9] provide procedures for identifying components that should have Hard Time (HT) inspection times. Components not having HT inspection times have On-Condition inspection times. Several optimization criteria (formulas) for determining HT inspection times are provided in each of these two RCM manuals. The inspection policy for an aircraft engine and its components is established in part by specifying the HT times for the appropriate SI items and the inspection procedures for the other On-Condition inspection items.

Maintenance policies formulated in this manner will have a consequent mix of engines that are inspected due to a failure and engines that are inspected by direction (without failure). Whatever this mix is, it is the appropriate mix if the optimization criteria used to determine the HT times is appropriate and the maintenance program is administered properly. The criteria for setting HT times will use time to failure distributions of these SI items and their associated reliability (probability of survival) and residual reliability (conditional probability of survival) expressions. Equations for these expressions were developed in Caudill's thesis [Ref. 2] and appear in Appendix B of this thesis in summary

form. These same expressions are appropriate for computing the reliability and residual reliability for any component using failure time data for that component.

It would not be appropriate to establish an "optimum" mix of scheduled and unscheduled engine removals using just mean-time-to-removal of engines and average repair costs. The maintenance program is too complex. The maintenance policy should be established accounting for safety, mission, engine design, component reliability, component residual reliability (time-related reliability) cost of maintenance actions and their benefit to component residual reliability, and other factors. RCM methodology is designed to account for these factors.

## C. ESTABLISHING NO-BUILD TIMES

In this section, a procedure is provided for determining the no-build time for a failed engine relative to the inspection Hard Times, HT, of its SI components. Suppose an engine has failed and an SI component with an HT time of $T_0$ hours has accumulated $t_0$ operating hours at the time of the engine failure. If $T_0 - t_0$ is sufficiently small, then the engine should not be rebuilt/repaired and returned to service without also performing the inspection/rebuild on the SI component which was intended to be done when $T_0$ operating hours had been accumulated. The lower limit of $T_0 - t_0$ for which a no-build decision is made is called the no-build time. Use of no-build times in a maintenance policy can save resources by performing maintenance on SI components while an engine is under repair for another purpose.

In this section, equations are provided for determining a cost-effective no-build value of $t_0$ given $T_0$. The method uses repair cost data and the failure time density functions of the HT component and the TF34 engine and their associated reliabilities and residual reliabilities.

The following notation is needed:

| | |
|---|---|
| $T_0$ : | HT time for the SI component. |
| T : | Random failure time of SI component. |
| f(t): | Failure density function for the SI component. |
| F(t): | $P(T \leq t)$. |
| $\bar{F}(t)$: | $P(T>t)$, reliability of SI component. |
| $\bar{F}(T_0 \backslash t_0)$ : | $P(T>T_0 \backslash T>t_0)$, residual reliability of SI component. |
| IR : | Inspect/Repair. |
| $C_N$: | IR cost of SI component at time of engine failure not due to SI component failures. |
| $C_I$ : | IR cost of SI component in a non-failed engine. Usually $C_N < C_I$. |
| $T_e$ : | Time to failure of TF34 engine. |
| $f_e(t)$ : | Failure density function for the TF34 engine. |
| $F_e(t)$ : | $P(T_e \leq t)$. |
| $\bar{F}_e$ : | $P(T_e>t)$, reliability of TF34 engine. |

The scenario for deciding whether or not to inspect/repair an SI component at the time of engine failure can be explained using Figure 7. Given the parent engine has failed at time $t_e$ and the SI component has accumulated $t_0$ operating hours and its HT time is $T_0$ hours, the SI

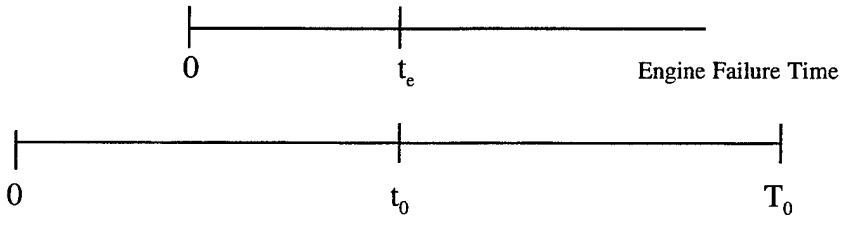



**Figure 7. SI Component Operating Time**

component should undergo IR now if the cost per unit of operating time is less than the average repair cost per unit of operating time if inspection is delayed until another engine failure or until it has accumulated $T_0$ operating hours. The approximate optimum time, $t_0$, is the solution for $t_0$ in the equation.

$$\frac{C_N}{t_0} = \left[ C_N \int_0^{T_0 - t_0} \frac{1}{t_0 + t} f_e(t)dt + \frac{C_I}{T_0} \overline{F}_e(T_0 - t_0) \right] \overline{F}(T_0 \backslash t_0) \qquad (7)$$

This equation is derived and discussed in Appendix D. It assumes that $\overline{F}(T_0 \backslash t_0)$ is close to one. The expression $C_N/t_0$ is the IR cost per unit operating time if IR is done at time of engine failure. The right hand member of equation (7) is the expected IR cost per unit operating time if IR is not done at time of engine failure. The solution for $t_0$ in equation (7) makes these costs per unit time equal. Therefore, if at time of engine failure, the accumulated operating time, t, on the SI component is less than $t_0$, IR should not be done on the SI component at time of engine failure. Rather, one should take the chance that another engine failure will occur before time $T_0$ - t has been accumulated on the engine, thus offering a better time to perform the IR on the SI component.

An alternative approach to solving equation (7) directly is to assume that $\overline{F}_e(T_0 - t_0)$ is close to one. This means the term with the integral sign in equation (7) is very small.

In this case, solve for $t_0$ in the equation:

$$\frac{C_N}{t_0} = \frac{C_I}{T_0} \overline{F}(T_0 \setminus t_0) \qquad (8)$$

After $t_0$ is computed using equation (8), compute $\overline{F}_e(T_0 - t_0)$ to see if it is close to one. If it is then use $t_0$ obtained from equation (8) as the solution to equation (7). If not, then equation (7) should be used to determine $t_0$.

## D. EXAMPLE SOLUTION FOR $t_0$

Suppose $F(t) = e^{-(t/\theta)^{\beta}}$ where $\theta$ and $\beta$ have been estimated using failure time data for an SI component. Then $\overline{F}(T_0 \backslash t_0) = e^{-(T_0/\theta)^{\beta}} e^{(t_0/\theta)^{\beta}}$. Suppose $\theta$ = 10,000 and $\beta$ = 1.5. Also suppose $C_N/C_I = .47$ and $T_0$ = 1000 hours. Using equation (8) to solve for $t_0$ :

$$\frac{C_N}{t_0} = \frac{C_I}{t_0} e^{-(T_0/\theta)^{\beta}} e^{(t_0/\theta)^{\beta}} \tag{9}$$

so that

$$T_0 \frac{C_N}{C_I} e^{(T_0/\theta)^{\beta}} = t_0 e^{(t_0/\theta)^{\beta}} \tag{10}$$

thus

$$1000(.47)\ e^{(.1)^{1.5}} = t_0 e^{[t_0/10{,}000]^{1.5}} \tag{11}$$

or

$$546.06 = t_0 e^{[t_0/10{,}000]^{1.5}}$$

By trial and error

$$t_0 = 506 \tag{12}$$

The reliability of a TF34 engine at 506 hours ($\theta$ = 500, $\beta$ = 1.5); i.e. $\overline{F}_e(506)$ is .3613, which is not close to one. Therefore, equation (7) should be used to solve for $t_0$ to get a larger value for $t_0$.

### 1. Spreadsheet Procedures for Solving $t_0$

The trial and error solution process for $t_0$ is a somewhat difficult. A spreadsheet template has been constructed to facilitate the calculations and is presented on Table 7. The solution for $t_0$ is accomplished by using the Goal Seek tools in Excel. Appendix B contains the spreadsheet procedures for using this template.

| Variable Description | Variable | Data Entry |
|---|---|---|
| High Time for the HT Component: | $T_0$ | 1000 |
| | | |
| Accumulated Time | $t_0$ | 506.14 |
| | | |
| Cost of Inspecting HT Component at Time of Engine Failure | $C_N$ | 470 |
| | | |
| Cost of Inspecting HT Component in a Non-Failed Engine | $C_I$ | 1000 |
| | | |
| Beta | Beta | 1.5 |
| | | |
| Failure Rate | Lambda | 0.0001 |

| Trial |
|---|
| 1000.00 |

**Table 7. $t_0$ Solution Template**

# V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## A. SUMMARY

The analyses performed in this thesis addressed the following questions:

- Has engine cannibalization had an increased adverse impact on MTBF of the TF34 engines in the most recent years?

- Does the reliability of TF34 engines decrease with the number of repair actions?

- How can conditional survival probabilities of Significant Items (components) and reliabilities of the TF34 engine be used to compute their cost-effective no-build times given their maximum operating time using Reliability Centered Maintenance concepts?

- What are the conditional and non-conditional reliability values and the MTBF of select sub-populations of the 5-year NALDA TF34 engine data base and how can this information be used to modify maintenance policy to increase the TF34 engine MTBF and reliability?

## B. CONCLUSIONS

1. Analyses in this thesis demonstrates that current cannibalization maintenance policies (FY93-94) have resulted in a lower MTBF for cannibalized TF34 engines for the FY93-94 time period than the corresponding MTBF values for 1992.

2. The large member of low failure times of repaired engines has a significant influence on MTBF of the TF34 engine. The number of zero time to failure values in the data base has decreased in the most recent years (FY93-94). A maintenance policy that targets eliminating zero failure times and 80% of the failure times less than 100 hours could increase MTBF as much as 19%.

3. The MTBF of TF34 engines is a function of the number of previous repairs. The MTBF of engines undergoing their first repair is about 44% larger than the average MTBF of engines undergoing their second, third, or fourth repair.

4. Mathematical equations were developed that can be used to compute cost-effective no-build times for Significant Items (SI) (i.e. components) of the TF34 engine. These equations use conditional survival probability values of the SI items,

reliability values of the TF34 engine, the maximum operating times of SI items, and three different cost of repair values for the SI items that reflect whether or not the engine is already broken out for repair or if the SI item has failed before its maximum operating time.

5. The data analysis with the TF34 five year data base was accomplished efficiently due to the fact the data was readable by desktop software programs. The author of this thesis made attempts to investigate the five year data base further by making cost data queries via Logistics Management Decision Support System (LMDSS). Currently, Naval Postgraduate School (NPS) does not have the computing facilities to interface with LMDSS efficiently, consequently, a detailed cost data is still difficult to acquire. The author made contact with the Naval Aviation Maintenance Office (NAMO) to hopefully gain the computing facilities, however, this effort must be approached from higher management levels at the Naval Postgraduate School.

## C. RECOMMENDATIONS

The following recommendations are offered as a result of the research performed in this thesis:

1. Focus attention on maintenance policy and procedures that will reduce the number of cannibalization maintenance actions and low failure times. The large number of zero FHSR engine records in the TF34 data base justify this action. Cannibalization actions represented the largest population of engine removals for the five year data base. A method for reducing cannibalizations may be to increase their visibility. For example, if a squadron has a readiness rate of 80%, which is above the Chief of Naval Operation's (CNO) goal for this particular aircraft, an engine cannibalization should not take place.

2. Broaden scope and depth of repair at the MIA level. The analysis in thesis demonstrated that as the number of successive repair actions MTBF decreased. A more in-depth and possible tighter inspection criteria may be a viable action to increase TF34 engine reliability.

3. Use test data on some selected SI items to compute their conditional survival probability (Non-Parametrically) and then compute their no-build times using equation (7) of this thesis. Then compare it with the no-build times currently in use. The ratio of costs, $C_I/C_N$, will be required to do this. If this ratio is not known, use equation (7) to determine what this ratio would have to be to arrive at the no-build times currently being used. Then ask if this derived ratio of cost is realistic. This is a topic for future study.

4. Methods and procedures for analyzing engine failures and removals can be accomplished using desktop software packages. All analysis in this thesis was accomplished with Microsoft Excel. These desktop software packages and programs should be made available where they could be useful.

5. Continue research into the problem of engine assembly to optimize the combination of life limited components that make up an engine at the IMA's and Depots. This is an extremely complex problem and it is generally managed without sophisticated decision support systems.

6. Install a LMDSS work station at the Naval Postgraduate School. This work station will allow real time data queries into the NALDA data base.

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# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0201021 | 3359 | 33 | 9572 | 2474 | 7K | S3B | 3Q | 8910 |
| * 0201022 | 3076 | 301 | 9646 | 2474 | 3Q | S3A | 2N | 8910 |
| * 0201127 | 4231 | 0 | 9298 | 2174 | 3W | S3A | 7C | 8910 |
| * 0202032 | 4485 | 1239 | 65885 | 3372 | 7D | | 7C | 8910 |
| * 0202034 | 2929 | 155 | 9629 | 2474 | 5W | S3B | 7C | 8910 |
| * 0202036 | 6133 | 1066 | 9192 | 2474 | 3Q | S3A | 7C | 8910 |
| * 0202045 | 2885 | 485 | 9572 | 2474 | 6J | S3B | 1Z | 8910 |
| * 0202060 | 4917 | 460 | 52947 | 2474 | 6M | US3A | 5D | 8910 |
| * 0202072 | 3636 | 1638 | 9192 | 2474 | 5Q | S3A | 1Z | 8910 |
| * 0202076 | 3632 | 0 | 3369 | 2475 | 7C | | 3Q | 8910 |
| * 0202092 | 3247 | 1633 | 9539 | 2474 | 7C | S3B | 5G | 8910 |
| * 0202108 | 4171 | 267 | 9572 | 2174 | 3W | S3B | 7D | 8910 |
| * 0202112 | 3728 | 79 | 63282 | 2474 | 4D | S3A | 4P | 8910 |
| * 0202157 | 3206 | 137 | 9226 | 2474 | 7C | S3B | 7C | 8910 |
| * 0202182 | 5234 | 3 | 65885 | 2374 | 4D | S3A | 7D | 8910 |
| * 0202182 | 5234 | 3 | 65885 | 3372 | 7C | | 7D | 8910 |
| * 0202229 | 3871 | 399 | 9739 | 2474 | 5Q | S3A | 3Q | 8910 |
| * 0202274 | 2888 | 731 | 9192 | 2174 | 3W | S3A | 7L | 8910 |
| * 0202294 | 3863 | 988 | 9539 | 2474 | 5Q | S3B | 7C | 8910 |
| * 0202336 | 4776 | 179 | 9572 | 2474 | 8F | S3B | 5Q | 8910 |
| * 0202355 | 4322 | 1298 | 65885 | 2374 | 4D | S3A | 3B | 8910 |
| * 0202356 | 4456 | 581 | 9381 | 2474 | 3Q | S3A | 7C | 8910 |
| * 0202357 | 2146 | 31 | 9226 | 2174 | 3W | S3A | 7C | 8910 |
| * 0202368 | 3690 | 176 | 9192 | 2474 | 5C | S3A | 7C | 8910 |
| * 0202374 | 2820 | 0 | 3367 | 2475 | 3W | | 3Q | 8910 |
| * 0202377 | 3519 | 427 | 9226 | 2174 | 3W | S3A | 7C | 8910 |
| * 0202386 | 4520 | 126 | 9204 | 2474 | 1Z | S3A | 1Z | 8910 |
| * 0202394 | 2317 | 673 | 9226 | 2174 | 3W | S3B | 7C | 8910 |
| * 0202410 | 4266 | 979 | 9572 | 2174 | 3W | S3B | 3Q | 8910 |
| * 0202419 | 1873 | 686 | 9739 | 2474 | 1W | S3A | 7C | 8910 |
| * 0202420 | 4405 | 226 | 9572 | 2474 | 7K | S3B | 5C | 8910 |
| * 0202422 | 3683 | 624 | 9353 | 2474 | 7C | S3A | 4D | 8910 |
| * 0202426 | 4468 | 889 | 9226 | 2474 | 7C | S3B | 5Q | 8910 |
| * 0201124 | 1421 | 20 | 9204 | 2174 | 3W | S3A | 3Q | 8911 |
| * 0202008 | 3165 | 242 | 9629 | 2174 | 3W | S3A | 3U | 8911 |
| * 0202049 | 5184 | 1318 | 65885 | 2374 | 4D | S3A | 1Z | 8911 |
| * 0202063 | 3016 | 722 | 421 | 2474 | 5D | S3A | 8F | 8911 |
| * 0202080 | 5481 | 3 | 9629 | 2474 | 3P | S3A | 7C | 8911 |
| * 0202091 | 3890 | 1099 | 9204 | 2174 | 3W | S3A | 7E | 8911 |
| * 0202127 | 5584 | 291 | 9263 | 2474 | 1Z | S3A | 5G | 8911 |
| * 0202136 | 4533 | 170 | 9539 | 2174 | 3W | S3A | 7C | 8911 |
| * 0202164 | 4930 | 250 | 9629 | 2174 | 3W | S3A | 7C | 8911 |
| * 0202169 | 4511 | 0 | 9353 | 2474 | 5Q | S3A | 5Q | 8911 |
| * 0202170 | 2741 | 1113 | 9263 | 2474 | 7D | S3A | 3Q | 8911 |
| * 0202192 | 4872 | 1635 | 9226 | 2174 | 3W | S3B | 5C | 8911 |
| * 0202237 | 4404 | 0 | 9298 | 2174 | 3W | S3A | 7C | 8911 |
| * 0202259 | 3098 | 304 | 9298 | 2474 | 1Z | S3A | 1Z | 8911 |
| * 0202262 | 5036 | 696 | 9646 | 2474 | 3Q | S3A | 3P | 8911 |
| * 0202286 | 1868 | 0 | 9353 | 2474 | 7K | S3A | 1Z | 8911 |
| * 0202293 | 4420 | 224 | 9353 | 2174 | 3W | S3A | 8F | 8911 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202304 | 3285 | 271 | 9353 | 2174 | 3W | S3A | 7C | 8911 |
| * 0202310 | 4249 | 1205 | 9539 | 2174 | 3W | S3A | 1W | 8911 |
| * 0202324 | 3986 | 860 | 9629 | 2474 | 5C | S3B | 8F | 8911 |
| * 0202338 | 3678 | 716 | 9192 | 2474 | 7C | S3A | 3D | 8911 |
| * 0202360 | 3304 | 145 | 9353 | 2174 | 3W | S3A | 1Z | 8911 |
| * 0202370 | 4750 | 263 | 9739 | 2474 | 6F | S3A | 3R | 8911 |
| * 0202379 | 3410 | 1223 | 9539 | 2174 | 3W | S3A | 3Q | 8911 |
| * 0202393 | 4800 | 667 | 52947 | 2474 | 1Z | US3A | 7L | 8911 |
| * 0202401 | 4167 | 305 | 65885 | 3372 | 3A | | 7D | 8911 |
| * 0202403 | 4299 | 1165 | 9539 | 2474 | 3T | S3B | 7D | 8911 |
| * 0202417 | 4806 | 1164 | 65885 | 3372 | 3A | | 7C | 8911 |
| * 0202422 | 3689 | 630 | 9353 | 2474 | 7C | S3A | 4D | 8911 |
| * 0202441 | 4799 | 0 | 9192 | 2474 | 5Q | S3A | 5G | 8911 |
| * 0202444 | 4619 | 846 | 65885 | 2374 | 4D | S3A | 3D | 8911 |
| * 0202444 | 4619 | 846 | 65885 | 3372 | 7D | | 3D | 8911 |
| * 0201116 | 4486 | 914 | 9572 | 2474 | 7C | S3B | 2N | 8912 |
| * 0201128 | 1942 | 9 | 9629 | 2174 | 3W | S3A | 3Q | 8912 |
| * 0201128 | 1945 | 12 | 9629 | 2174 | 3W | S3A | 3Q | 8912 |
| * 0202005 | 4762 | 615 | 9381 | 2474 | 1Z | S3A | 3Q | 8912 |
| * 0202009 | 4697 | 352 | 9539 | 2174 | 3W | S3B | 5C | 8912 |
| * 0202012 | 4390 | 243 | 9263 | 2174 | 3W | S3A | 1Z | 8912 |
| * 0202018 | 4135 | 229 | 9204 | 2474 | 1Z | S3A | 3R | 8912 |
| * 0202026 | 5538 | 516 | 9629 | 2474 | 1Z | S3A | 5C | 8912 |
| * 0202053 | 5001 | 740 | 9629 | 2474 | 7C | S3B | 7C | 8912 |
| * 0202064 | 5122 | 809 | 9204 | 2474 | 7A | S3A | 5C | 8912 |
| * 0202067 | 1676 | 11 | 9629 | 2174 | 3W | S3A | 5C | 8912 |
| * 0202080 | 5483 | 2 | 9629 | 2474 | 3P | S3A | 3M | 8912 |
| * 0202084 | 4981 | 0 | 9298 | 2174 | 3W | S3A | 5Q | 8912 |
| * 0202101 | 4322 | 848 | 9263 | 2174 | 3W | S3A | 3Q | 8912 |
| * 0202106 | 2335 | 923 | 9353 | 2174 | 3W | S3A | 1G | 8912 |
| * 0202112 | 3728 | 0 | 9298 | 2174 | 3W | S3A | 3T | 8912 |
| * 0202120 | 2920 | 660 | 60200 | 3172 | 5C | | 7C | 8912 |
| * 0202125 | 5802 | 704 | 52947 | 2474 | 7L | US3A | 1Z | 8912 |
| * 0202130 | 4758 | 200 | 9572 | 2174 | 3W | S3B | 3T | 8912 |
| * 0202154 | 4694 | 1073 | 9629 | 2174 | 3W | S3A | 2C | 8912 |
| * 0202158 | 5234 | 202 | 9646 | 2474 | 3Q | S3A | 5C | 8912 |
| * 0202171 | 4147 | 327 | 9539 | 2174 | 3W | S3A | 7K | 8912 |
| * 0202176 | 4008 | 11 | 9298 | 2474 | 2N | S3A | 1Z | 8912 |
| * 0202237 | 4470 | 66 | 9298 | 2474 | 2S | S3A | 7C | 8912 |
| * 0202245 | 4226 | 0 | 9353 | 2474 | 2S | S3A | 7C | 8912 |
| * 0202276 | 4478 | 764 | 9287 | 2474 | 7C | S3B | 5W | 8912 |
| * 0202281 | 4920 | 1547 | 9539 | 2174 | 3W | S3B | 5Q | 8912 |
| * 0202282 | 5246 | 2 | 9646 | 2474 | 4P | S3A | 3R | 8912 |
| * 0202310 | 4249 | 1205 | 9539 | 2174 | 3W | S3A | 1W | 8912 |
| * 0202312 | 3249 | 719 | 9572 | 2474 | 7C | S3B | 3R | 8912 |
| * 0202313 | 3100 | 139 | 9539 | 2174 | 3W | S3B | 3Q | 8912 |
| * 0202317 | 3723 | 518 | 9287 | 2174 | 4D | S3B | 1Z | 8912 |
| * 0202319 | 4814 | 112 | 9298 | 2174 | 3W | S3A | 1Z | 8912 |
| * 0202326 | 4399 | 444 | 9263 | 2174 | 3W | S3A | 7K | 8912 |
| * 0202348 | 4513 | 54 | 9263 | 2174 | 3W | S3A | 5D | 8912 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202388 | 3562 | 76 | 9192 | 2174 | 3W | S3A | 2N | 8912 |
| * 0202391 | 3158 | 283 | 9572 | 2474 | 7C | S3B | 7C | 8912 |
| * 0202397 | 1931 | 356 | 9539 | 2474 | 7C | S3A | 7K | 8912 |
| * 0202400 | 4158 | 1611 | 9539 | 2474 | 7C | S3B | 1W | 8912 |
| * 0202428 | 3009 | 52 | 9629 | 2174 | 3W | S3B | 3Q | 8912 |
| * 0202431 | 3508 | 694 | 9192 | 2474 | 7C | S3A | 7C | 8912 |
| * 0201118 | 5056 | 67 | 9739 | 2474 | 6F | S3A | 7D | 9001 |
| * 0202009 | 4788 | 443 | 9539 | 2174 | 4D | S3B | 5C | 9001 |
| * 0202011 | 3589 | 421 | 9539 | 2174 | 4D | S3A | 7C | 9001 |
| * 0202015 | 3893 | 859 | 9629 | 2174 | 3W | S3A | 5C | 9001 |
| * 0202040 | 4045 | 385 | 9204 | 2174 | 3W | S3A | 5Q | 9001 |
| * 0202046 | 4773 | 798 | 52947 | 2474 | 7C | US3A | 1W | 9001 |
| * 0202054 | 3314 | 656 | 9739 | 2474 | 5C | S3A | 5B | 9001 |
| * 0202064 | 5122 | 0 | 246 | 2475 | 7A |  | 7A | 9001 |
| * 0202091 | 3894 | 1103 | 65885 | 3372 | 7D |  | 7E | 9001 |
| * 0202097 | 3421 | 700 | 9204 | 2174 | 3W | S3A | 7C | 9001 |
| * 0202102 | 4724 | 918 | 9192 | 2174 | 3W | S3A | 5C | 9001 |
| * 0202145 | 3314 | 178 | 9629 | 2174 | 3W | S3B | 5C | 9001 |
| * 0202156 | 5689 | 958 | 9353 | 2174 | 4D | S3A | 5C | 9001 |
| * 0202162 | 6255 | 1607 | 9381 | 2474 | 3W | S3A | 7C | 9001 |
| * 0202174 | 5451 | 814 | 9192 | 2174 | 3W | S3A | 7C | 9001 |
| * 0202178 | 4656 | 464 | 9381 | 2174 | 5G | S3A | 4D | 9001 |
| * 0202185 | 3979 | 0 | 3367 | 2475 | 2A |  | 3Q | 9001 |
| * 0202202 | 5002 | 1421 | 65885 | 2374 | 4D | US3A | 2A | 9001 |
| * 0202206 | 3892 | 57 | 52947 | 2474 | 3P | US3A | 3P | 9001 |
| * 0202211 | 3413 | 62 | 9353 | 2474 | 3U | S3A | 8F | 9001 |
| * 0202217 | 4959 | 335 | 9381 | 2474 | 3W | S3A | 7J | 9001 |
| * 0202220 | 2913 | 315 | 9287 | 2474 | 1Z | S3B | 1Z | 9001 |
| * 0202223 | 6509 | 0 | 3365 | 2475 | 6J |  | 3T | 9001 |
| * 0202235 | 4357 | 144 | 65885 | 2374 | 4D | US3A | 3R | 9001 |
| * 0202261 | 4839 | 250 | 9353 | 2174 | 4D | S3A | 3Q | 9001 |
| * 0202267 | 5742 | 385 | 9646 | 2474 | 3Q | S3A | 4M | 9001 |
| * 0202272 | 3895 | 0 | 3359 | 2475 | 3Q |  | 7C | 9001 |
| * 0202278 | 5393 | 914 | 9539 | 2174 | 3W | S3A | 7C | 9001 |
| * 0202301 | 2035 | 787 | 65885 | 3372 | 7D |  | 3Q | 9001 |
| * 0202306 | 3383 | 113 | 9629 | 2474 | 1Z | S3B | 1Z | 9001 |
| * 0202307 | 4483 | 1209 | 9539 | 2474 | 7C | S3B | 7E | 9001 |
| * 0202328 | 2225 | 394 | 52947 | 2474 | 3R | US3A | 7C | 9001 |
| * 0202338 | 3678 | 0 | 9381 | 2475 | 7K |  | 7C | 9001 |
| * 0202360 | 3352 | 193 | 9353 | 2174 | 3W | S3A | 1Z | 9001 |
| * 0202360 | 3352 | 193 | 9353 | 2474 | 1G | S3A | 1Z | 9001 |
| * 0202361 | 3295 | 484 | 9353 | 2474 | 1W | S3A | 7C | 9001 |
| * 0202377 | 3701 | 609 | 9226 | 2474 | 3Q | S3B | 7C | 9001 |
| * 0202416 | 2853 | 20 | 9381 | 2174 | 5G | S3A | 3Q | 9001 |
| * 0202419 | 1921 | 48 | 52947 | 2474 | 1W | US3A | 1W | 9001 |
| * 0202421 | 3971 | 525 | 9192 | 2174 | 3W | S3A | 7D | 9001 |
| * 0202439 | 4403 | 811 | 9298 | 2474 | 3Q | S3A | 6O | 9001 |
| * 0201101 | 4805 | 685 | 9739 | 2474 | 4P | S3A | 5G | 9002 |
| * 0201109 | 3606 | 211 | 9298 | 2474 | 5C | S3A | 5G | 9002 |
| * 0201116 | 4486 | 0 | 21297 | 2475 | 3W |  | 7C | 9002 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0201125 | 4018 | 92 | 9572 | 2174 | 3W | S3B | 3Q | 9002 |
| * 0202024 | 3979 | 508 | 9204 | 2474 | 1W | S3A | 7C | 9002 |
| * 0202037 | 4957 | 2 | 9739 | 2474 | 6F | S3A | 7K | 9002 |
| * 0202049 | 5186 | 1320 | 65885 | 2374 | 4D | S3A | 1Z | 9002 |
| * 0202049 | 5186 | 1320 | 65885 | 3372 | 5Q | | 1Z | 9002 |
| * 0202058 | 5065 | 320 | 9192 | 2474 | 4R | S3A | 7D | 9002 |
| * 0202062 | 4464 | 40 | 9353 | 2474 | 1W | S3A | 7C | 9002 |
| * 0202068 | 4261 | 1422 | 9539 | 2174 | 3W | S3B | 7C | 9002 |
| * 0202070 | 4098 | 1823 | 9353 | 2474 | 7D | S3A | 4R | 9002 |
| * 0202076 | 3715 | 83 | 9572 | 2474 | 2N | S3B | 7C | 9002 |
| * 0202081 | 4545 | 187 | 9298 | 2174 | 3W | S3A | 4P | 9002 |
| * 0202101 | 4326 | 852 | 65885 | 3372 | 3A | | 3Q | 9002 |
| * 0202106 | 2337 | 925 | 9353 | 2174 | 3W | S3A | 1G | 9002 |
| * 0202106 | 2374 | 962 | 9353 | 2474 | 7C | S3A | 1G | 9002 |
| * 0202107 | 1273 | 74 | 63282 | 2374 | 4D | S3A | | 9002 |
| * 0202108 | 4333 | 429 | 9572 | 2174 | 3W | S3B | 7D | 9002 |
| * 0202121 | 5454 | 1070 | 9572 | 2174 | 3W | S3B | 6F | 9002 |
| * 0202121 | 5454 | 1070 | 9353 | 2174 | 4D | S3A | 6F | 9002 |
| * 0202132 | 4347 | 327 | 9629 | 2174 | 3W | S3A | 2N | 9002 |
| * 0202154 | 4747 | 1126 | 9539 | 2474 | 7C | S3A | 2C | 9002 |
| * 0202171 | 4182 | 362 | 65885 | 2374 | 4D | S3B | 7K | 9002 |
| * 0202171 | 4182 | 362 | 65885 | 3372 | 3A | | 7K | 9002 |
| * 0202228 | 4951 | 0 | 20993 | 2475 | 3W | | 5G | 9002 |
| * 0202241 | 4267 | 1114 | 9263 | 2474 | 7C | S3A | 4D | 9002 |
| * 0202257 | 4967 | 552 | 9539 | 2474 | 7C | S3B | 3B | 9002 |
| * 0202261 | 4839 | 250 | 9539 | 2174 | 3W | S3A | 3Q | 9002 |
| * 0202271 | 5771 | 0 | 3364 | 2475 | 3W | | 7C | 9002 |
| * 0202278 | 5425 | 946 | 9572 | 2474 | 2N | S3B | 7C | 9002 |
| * 0202281 | 4928 | 1555 | 65885 | 3372 | 3A | | 5Q | 9002 |
| * 0202291 | 4002 | 672 | 9629 | 2174 | 3W | S3A | 7C | 9002 |
| * 0202299 | 5315 | 483 | 9739 | 2474 | 6F | S3A | 5G | 9002 |
| * 0202307 | 4486 | 3 | 9572 | 2174 | 3W | S3B | 7C | 9002 |
| * 0202314 | 2674 | 198 | 9192 | 2174 | 3W | S3A | 7L | 9002 |
| * 0202317 | 3723 | 518 | 9629 | 2174 | 3W | S3B | 1Z | 9002 |
| * 0202326 | 4403 | 448 | 65885 | 3372 | 3A | | 7K | 9002 |
| * 0202385 | 4054 | 1322 | 9192 | 2474 | 7C | S3A | 3R | 9002 |
| * 0202390 | 4825 | 347 | 9646 | 2474 | 7A | S3A | 7C | 9002 |
| * 0202392 | 2619 | 55 | 63282 | 2374 | 4D | S3A | 1Z | 9002 |
| * 0202410 | 4454 | 1167 | 9572 | 2174 | 3W | S3B | 3Q | 9002 |
| * 0202420 | 4459 | 54 | 9539 | 2174 | 3W | S3A | 3Q | 9002 |
| * 0202421 | 3974 | 528 | 65885 | 2374 | 4D | S3A | 7D | 9002 |
| * 0201102 | 5148 | 310 | 9539 | 2474 | 4M | S3B | 5G | 9003 |
| * 0201113 | 5162 | 111 | 9353 | 2174 | 3W | S3A | 3Q | 9003 |
| * 0201120 | 4930 | 1744 | 9192 | 2174 | 3W | S3A | 7C | 9003 |
| * 0201124 | 1582 | 181 | 9263 | 2174 | 3W | S3A | 3Q | 9003 |
| * 0201127 | 4525 | 294 | 9539 | 2474 | 4M | S3B | 7C | 9003 |
| * 0202004 | 5082 | 0 | 9192 | 2174 | 3W | S3A | 7C | 9003 |
| * 0202012 | 4532 | 385 | 9263 | 2474 | 6E | S3A | 1Z | 9003 |
| * 0202027 | 4412 | 1441 | 9192 | 2474 | 3T | S3A | 7K | 9003 |
| * 0202033 | 4307 | 1183 | 9287 | 2474 | 3A | S3B | 8F | 9003 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202045 | 2929 | 44 | 9572 | 2474 | 3R | S3B | 5C | 9003 |
| * 0202051 | 3451 | 326 | 9381 | 2174 | 3W | S3A | 2N | 9003 |
| * 0202052 | 3911 | 611 | 9192 | 2474 | 7C | S3A | 3B | 9003 |
| * 0202056 | 2497 | 560 | 9381 | 2474 | 7C | S3A | 8C | 9003 |
| * 0202068 | 4261 | 1422 | 9539 | 2174 | 3W | S3A | 7C | 9003 |
| * 0202086 | 2080 | 116 | 9629 | 2474 | 3Q | S3B | 3R | 9003 |
| * 0202102 | 4727 | 921 | 65885 | 3372 | 3A | | 5C | 9003 |
| * 0202107 | 1273 | 74 | 246 | 2475 | 3R | | | 9003 |
| * 0202118 | 4807 | 1603 | 9539 | 2474 | 7C | S3B | 3A | 9003 |
| * 0202131 | 4540 | 404 | 9226 | 2474 | 3Q | S3B | 7C | 9003 |
| * 0202137 | 4753 | 916 | 9739 | 2474 | 1Z | S3A | 4D | 9003 |
| * 0202149 | 4595 | 485 | 9539 | 2474 | 3A | S3B | 7C | 9003 |
| * 0202151 | 4353 | 467 | 9192 | 2474 | 5D | S3A | 3P | 9003 |
| * 0202162 | 6255 | 0 | 9192 | 2174 | 3W | S3A | 7C | 9003 |
| * 0202166 | 3428 | 191 | 9539 | 2174 | 3W | S3A | 7C | 9003 |
| * 0202166 | 3439 | 202 | 9539 | 2174 | 3W | S3A | 7C | 9003 |
| * 0202172 | 4481 | 735 | 9539 | 2474 | 7C | S3A | 1G | 9003 |
| * 0202199 | 5800 | 753 | 9539 | 2174 | 3W | S3B | 1Z | 9003 |
| * 0202208 | 4624 | 688 | 9381 | 2174 | 3W | S3A | 5B | 9003 |
| * 0202208 | 4624 | 688 | 9381 | 2474 | 6Q | S3A | 5B | 9003 |
| * 0202232 | 5360 | 1462 | 9298 | 2174 | 3W | S3A | 1Z | 9003 |
| * 0202233 | 5394 | 1370 | 9381 | 2474 | 1W | S3A | 3Q | 9003 |
| * 0202238 | 4702 | 555 | 9646 | 2474 | 7C | S3A | 1Z | 9003 |
| * 0202256 | 4525 | 1102 | 9381 | 2174 | 3W | S3A | 5C | 9003 |
| * 0202271 | 5791 | 20 | 9263 | 2474 | 5C | S3A | 3W | 9003 |
| * 0202313 | 3252 | 291 | 9539 | 2174 | 3W | S3A | 3Q | 9003 |
| * 0202315 | 3740 | 1074 | 9287 | 2474 | 7C | S3B | 7C | 9003 |
| * 0202317 | 3800 | 595 | 9629 | 2474 | 7C | S3B | 1Z | 9003 |
| * 0202319 | 4970 | 268 | 9298 | 2474 | 1Z | S3A | 1Z | 9003 |
| * 0202327 | 4909 | 297 | 52947 | 2174 | 3W | US3A | 3D | 9003 |
| * 0202331 | 3163 | 421 | 65885 | 3372 | 3A | | 5D | 9003 |
| * 0202348 | 4555 | 96 | 9263 | 2474 | 7K | S3A | 5D | 9003 |
| * 0202373 | 3958 | 333 | 9226 | 2474 | 1G | S3B | 7C | 9003 |
| * 0202381 | 2836 | 52 | 9192 | 2174 | 3W | S3A | 7K | 9003 |
| * 0202383 | 4488 | 704 | 52947 | 2474 | 1Z | US3A | 7L | 9003 |
| * 0202392 | 2619 | 55 | 246 | 2475 | 3R | | 1Z | 9003 |
| * 0202399 | 3930 | 291 | 52947 | 2474 | 6N | US3A | 6F | 9003 |
| * 0202402 | 5019 | 2120 | 9353 | 2174 | 3W | S3A | 3Q | 9003 |
| * 0202402 | 5027 | 2128 | 9353 | 2474 | 1Z | S3A | 3Q | 9003 |
| * 0202404 | 4700 | 145 | 9539 | 2174 | 3W | S3A | 7C | 9003 |
| * 0202410 | 4463 | 1176 | 65885 | 3372 | 3A | | 3Q | 9003 |
| * 0202412 | 4554 | 1551 | 9539 | 2174 | 3W | S3A | 7K | 9003 |
| * 0202428 | 3059 | 102 | 9629 | 2174 | 3W | S3B | 3Q | 9003 |
| * 0202440 | 4588 | 116 | 9204 | 2474 | 4P | S3A | 6Q | 9003 |
| * 0201104 | 5166 | 293 | 65885 | 3372 | 3A | | 1Z | 9004 |
| * 0201120 | 5026 | 1840 | 9192 | 2474 | 7D | S3A | 7C | 9004 |
| * 0202007 | 1778 | 616 | 9287 | 2174 | 4D | S3B | 3R | 9004 |
| * 0202007 | 1778 | 616 | 9646 | 2475 | 7C | | 3R | 9004 |
| * 0202010 | 4107 | 415 | 9226 | 2474 | 1G | S3B | 5C | 9004 |
| * 0202121 | 5516 | 1132 | 65885 | 3372 | 7C | | 6F | 9004 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202136 | 4644 | 281 | 9539 | 2174 | 3W | S3A | 7C | 9004 |
| * 0202162 | 6314 | 59 | 9192 | 2174 | 3W | S3A | 7C | 9004 |
| * 0202164 | 5017 | 337 | 65885 | 3372 | 3A | | 7C | 9004 |
| * 0202166 | 3491 | 254 | 9539 | 2174 | 3W | S3A | 7C | 9004 |
| * 0202217 | 4959 | 0 | 9192 | 2174 | 3W | S3A | 7C | 9004 |
| * 0202271 | 5791 | 20 | 9263 | 2474 | 5C | S3A | 3W | 9004 |
| * 0202283 | 3239 | 91 | 9539 | 2174 | 3W | S3A | 7C | 9004 |
| * 0202307 | 4593 | 110 | 9353 | 2174 | 3W | S3A | 7C | 9004 |
| * 0202311 | 3752 | 27 | 9263 | 2474 | 5C | S3A | 3R | 9004 |
| * 0202334 | 5165 | 1178 | 9353 | 2174 | 3W | S3A | 5C | 9004 |
| * 0202341 | 5337 | 845 | 9263 | 2174 | 3W | S3A | 7D | 9004 |
| * 0202355 | 4490 | 1466 | 9298 | 2474 | 7C | S3A | 3B | 9004 |
| * 0202356 | 4658 | 202 | 9204 | 2474 | 1G | S3A | 5D | 9004 |
| * 0202363 | 4001 | 888 | 9226 | 2474 | 1Z | S3B | 5C | 9004 |
| * 0202412 | 4576 | 1573 | 9539 | 2174 | 3W | S3A | 7K | 9004 |
| * 0202428 | 3119 | 162 | 9629 | 2474 | 3Q | S3B | 3Q | 9004 |
| * 0202438 | 4406 | 407 | 9646 | 2174 | 3W | S3A | 5C | 9004 |
| * 0201113 | 5281 | 230 | 9353 | 2174 | 3W | S3A | 3Q | 9005 |
| * 0201120 | 5041 | 15 | 9263 | 2474 | 6N | S3A | 7D | 9005 |
| * 0201124 | 1610 | 209 | 9263 | 2174 | 3W | S3A | 3Q | 9005 |
| * 0202002 | 4362 | 402 | 9739 | 2174 | 3W | S3A | 6P | 9005 |
| * 0202020 | 4116 | 959 | 9263 | 2174 | 3W | S3A | 8C | 9005 |
| * 0202025 | 4844 | 569 | 9298 | 2174 | 3W | S3A | 1Z | 9005 |
| * 0202030 | 3567 | 688 | 9263 | 2474 | 1Z | S3A | 2N | 9005 |
| * 0202035 | 2618 | 816 | 9381 | 2474 | 7C | S3A | 1Z | 9005 |
| * 0202040 | 4173 | 513 | 9263 | 2474 | 7C | S3A | 5Q | 9005 |
| * 0202043 | 5036 | 589 | 9381 | 2174 | 4D | S3A | 3D | 9005 |
| * 0202051 | 3599 | 474 | 9381 | 2174 | 4D | S3A | 2N | 9005 |
| * 0202068 | 4447 | 1608 | 9539 | 2474 | 7C | S3B | 7C | 9005 |
| * 0202069 | 5017 | 404 | 65885 | 2374 | 4D | US3A | 7L | 9005 |
| * 0202071 | 3765 | 339 | 9192 | 2174 | 3W | S3A | 7L | 9005 |
| * 0202071 | 3765 | 339 | 9192 | 2474 | 7D | S3A | 7L | 9005 |
| * 0202074 | 3558 | 199 | 9646 | 2474 | 2N | S3A | 3W | 9005 |
| * 0202081 | 4631 | 273 | 9298 | 2174 | 3W | S3A | 4P | 9005 |
| * 0202085 | 4858 | 82 | 9298 | 2474 | 1W | S3A | 7D | 9005 |
| * 0202098 | 4123 | 210 | 9298 | 2174 | 4D | S3A | 5Q | 9005 |
| * 0202140 | 2561 | 390 | 9739 | 2174 | 3W | S3A | 7C | 9005 |
| * 0202160 | 4217 | 691 | 421 | 2474 | 7C | S3B | 5Q | 9005 |
| * 0202161 | 4515 | 653 | 9287 | 2474 | 1Z | S3B | 3W | 9005 |
| * 0202167 | 3517 | 432 | 9739 | 2174 | 3W | S3A | 5Q | 9005 |
| * 0202180 | 5317 | 821 | 9298 | 2474 | 5G | S3A | 7C | 9005 |
| * 0202182 | 5430 | 196 | 9353 | 2174 | 3W | S3A | 7C | 9005 |
| * 0202186 | 4357 | 381 | 52947 | 2474 | 2N | US3A | 1Z | 9005 |
| * 0202201 | 4643 | 1482 | 9353 | 2474 | 5Q | S3B | 6A | 9005 |
| * 0202206 | 3923 | 31 | 65885 | 2374 | 4D | US3A | 3P | 9005 |
| * 0202208 | 4624 | 0 | 9192 | 2174 | 3W | S3A | 6Q | 9005 |
| * 0202209 | 4521 | 401 | 52947 | 2474 | 6P | US3A | 7C | 9005 |
| * 0202219 | 4495 | 426 | 9739 | 2174 | 3W | S3A | 5G | 9005 |
| * 0202223 | 6626 | 117 | 52947 | 2474 | 3R | US3A | 6Y | 9005 |
| * 0202226 | 3405 | 361 | 65885 | 3372 | 3A | | 3W | 9005 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202247 | 3621 | 879 | 9646 | 2474 | 3Q | S3A | 7C | 9005 |
| * 0202253 | 5297 | 402 | 9739 | 2174 | 3W | S3A | 3M | 9005 |
| * 0202278 | 5470 | 45 | 9629 | 2474 | 3Q | S3B | 2N | 9005 |
| * 0202291 | 4146 | 816 | 9572 | 2474 | 3R | S3B | 7C | 9005 |
| * 0202317 | 3808 | 8 | 9263 | 2174 | 3W | S3A | 7C | 9005 |
| * 0202323 | 4442 | 196 | 9353 | 2174 | 3W | S3A | 8C | 9005 |
| * 0202339 | 4272 | 738 | 9226 | 2474 | 7C | S3B | 3Q | 9005 |
| * 0202342 | 2825 | 42 | 52947 | 2474 | 6T | US3A | 7E | 9005 |
| * 0202353 | 4479 | 691 | 421 | 2474 | 7C | S3B | 5C | 9005 |
| * 0202354 | 4880 | 1447 | 9739 | 2174 | 3W | S3A | 6F | 9005 |
| * 0202355 | 4491 | 1 | 9298 | 2474 | 3Q | S3A | 7C | 9005 |
| * 0202367 | 4118 | 46 | 52947 | 2474 | 8C | US3A | 1Z | 9005 |
| * 0202380 | 4716 | 953 | 9263 | 2474 | 1Z | S3A | 5D | 9005 |
| * 0202416 | 3059 | 226 | 9381 | 2174 | 4D | S3A | 3Q | 9005 |
| * 0202423 | 4079 | 1246 | 9646 | 2174 | 3W | S3A | 6Q | 9005 |
| * 0201113 | 5313 | 262 | 9353 | 2474 | 1Z | S3B | 3Q | 9006 |
| * 0201128 | 2233 | 300 | 9629 | 2174 | 3W | S3B | 3Q | 9006 |
| * 0202022 | 4387 | 40 | 9739 | 2474 | 3T | S3A | 7D | 9006 |
| * 0202035 | 2619 | 1 | 9192 | 2174 | 3W | S3A | 7C | 9006 |
| * 0202054 | 3349 | 35 | 52947 | 2474 | 6F | US3A | 5C | 9006 |
| * 0202083 | 3548 | 405 | 9204 | 2474 | 2C | S3A | 7J | 9006 |
| * 0202086 | 2096 | 16 | 9539 | 2174 | 3W | S3A | 2S | 9006 |
| * 0202095 | 5605 | 428 | 9192 | 2474 | 7D | S3A | 3T | 9006 |
| * 0202128 | 4239 | 421 | 9646 | 2174 | 3W | S3A | 5C | 9006 |
| * 0202141 | 4315 | 988 | 9646 | 2474 | 7C | S3A | 3T | 9006 |
| * 0202162 | 6342 | 87 | 9192 | 2174 | 3W | S3A | 7C | 9006 |
| * 0202163 | 2813 | 356 | 9381 | 2174 | 4D | S3A | 7C | 9006 |
| * 0202169 | 4511 | 0 | 421 | 2174 | 3W | S3B | 5Q | 9006 |
| * 0202207 | 5319 | 434 | 9539 | 2474 | 1Z | S3B | 5Q | 9006 |
| * 0202241 | 4310 | 43 | 9298 | 2174 | 4D | S3A | 7C | 9006 |
| * 0202253 | 5298 | 403 | 9739 | 2174 | 3W | S3A | 3M | 9006 |
| * 0202263 | 5172 | 416 | 9192 | 2174 | 3W | S3A | 3Q | 9006 |
| * 0202266 | 3218 | 882 | 421 | 2474 | 3P | S3A | 4J | 9006 |
| * 0202269 | 3596 | 16 | 9539 | 2174 | 3W | S3A | 7C | 9006 |
| * 0202273 | 4610 | 823 | 9298 | 2174 | 4D | S3A | 3W | 9006 |
| * 0202283 | 3275 | 127 | 9539 | 2174 | 3W | S3A | 7C | 9006 |
| * 0202293 | 4634 | 438 | 9353 | 2474 | 1Z | S3A | 8F | 9006 |
| * 0202297 | 4698 | 927 | 9381 | 2174 | 4D | S3A | 1Z | 9006 |
| * 0202297 | 4698 | 927 | 9298 | 2474 | 5G | S3A | 1Z | 9006 |
| * 0202302 | 5082 | 211 | 9381 | 2474 | 1G | S3A | 5C | 9006 |
| * 0202304 | 3304 | 290 | 9353 | 2474 | 1Z | S3B | 7C | 9006 |
| * 0202314 | 2910 | 434 | 9192 | 2174 | 3W | S3A | 7L | 9006 |
| * 0202360 | 3546 | 387 | 9572 | 2474 | 3P | S3B | 1Z | 9006 |
| * 0202378 | 4138 | 230 | 9298 | 2474 | 3Q | S3A | 5Q | 9006 |
| * 0202379 | 3804 | 1617 | 9539 | 2474 | 1C | S3B | 3Q | 9006 |
| * 0202384 | 4146 | 734 | 9646 | 2174 | 3W | S3A | 1Z | 9006 |
| * 0202386 | 4539 | 19 | 9263 | 2474 | 2A | S3A | 1Z | 9006 |
| * 0202394 | 2496 | 852 | 9353 | 2474 | 7C | S3A | 7C | 9006 |
| * 0202401 | 4199 | 32 | 9353 | 2174 | 3W | S3A | 3A | 9006 |
| * 0202412 | 4594 | 1591 | 9353 | 2174 | 3W | S3A | 7K | 9006 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202417 | 4837 | 31 | 9353 | 2174 | 3W | S3A | 3A | 9006 |
| * 0201112 | 5189 | 927 | 9572 | 2474 | 3P | S3B | 5G | 9007 |
| * 0201123 | 4543 | 854 | 9263 | 2474 | 7C | S3A | 2N | 9007 |
| * 0202009 | 4854 | 509 | 55600 | 2474 | 7C | S3A | 5C | 9007 |
| * 0202031 | 5534 | 791 | 9298 | 2474 | 6F | S3A | 6Q | 9007 |
| * 0202047 | 3116 | 1219 | 65885 | 2374 | 4D | S3A | 5W | 9007 |
| * 0202055 | 5376 | 592 | 52947 | 2474 | 7L | US3A | 6F | 9007 |
| * 0202089 | 4435 | 226 | 9298 | 2174 | 3W | S3A | 5C | 9007 |
| * 0202089 | 4435 | 226 | 9298 | 2474 | 7A | S3A | 5C | 9007 |
| * 0202103 | 2347 | 1363 | 65885 | 2374 | 4D | S3A | | 9007 |
| * 0202128 | 4243 | 425 | 9646 | 2174 | 3W | S3A | 5C | 9007 |
| * 0202139 | 4658 | 404 | 9539 | 2474 | 5Q | S3B | 3Q | 9007 |
| * 0202192 | 5056 | 1819 | 9646 | 2174 | 3W | S3A | 5C | 9007 |
| * 0202202 | 5036 | 1455 | 52947 | 2474 | 7C | US3A | 2A | 9007 |
| * 0202203 | 3448 | 679 | 9539 | 2474 | 1Z | S3B | 3Q | 9007 |
| * 0202233 | 5394 | 0 | 9298 | 2174 | 3W | S3A | 3T | 9007 |
| * 0202236 | 5822 | 1360 | 9226 | 2174 | 4D | S3B | 7D | 9007 |
| * 0202261 | 5025 | 436 | 9539 | 2474 | 2S | S3B | 3Q | 9007 |
| * 0202293 | 4634 | 0 | 9646 | 2174 | 3W | S3A | 1Z | 9007 |
| * 0202307 | 4686 | 203 | 9353 | 2474 | 7C | S3A | 7C | 9007 |
| * 0202322 | 4028 | 117 | 9226 | 2174 | 4D | S3B | 7C | 9007 |
| * 0202363 | 4005 | 4 | 9646 | 2174 | 3W | S3A | 1Z | 9007 |
| * 0202366 | 4428 | 56 | 9298 | 2474 | 2C | S3A | 5D | 9007 |
| * 0202380 | 4746 | 30 | 9298 | 2174 | 3W | S3A | 1Z | 9007 |
| * 0202400 | 4288 | 130 | 9226 | 2174 | 4D | S3B | 6P | 9007 |
| * 0202412 | 4603 | 1600 | 9646 | 2174 | 3W | S3A | 7K | 9007 |
| * 0202413 | 4508 | 336 | 9572 | 2474 | 7C | S3B | 2C | 9007 |
| * 0201022 | 3100 | 24 | 9646 | 2174 | 3W | S3A | 3Q | 9008 |
| * 0201022 | 3115 | 39 | 9646 | 2474 | 8P | S3A | 3Q | 9008 |
| * 0201118 | 5094 | 0 | 68539 | 2475 | 4A | | 6F | 9008 |
| * 0202008 | 3454 | 531 | 9629 | 2474 | 7C | S3B | 3U | 9008 |
| * 0202011 | 3648 | 480 | 55600 | 2174 | 3W | S3A | 7C | 9008 |
| * 0202034 | 2929 | 0 | 21247 | 2475 | 6A | | 5C | 9008 |
| * 0202038 | 3546 | 922 | 9298 | 2174 | 3W | S3A | 7D | 9008 |
| * 0202049 | 5196 | 10 | 9539 | 2174 | 3W | S3A | 5Q | 9008 |
| * 0202049 | 5196 | 10 | 9539 | 2474 | 8P | S3A | 5Q | 9008 |
| * 0202051 | 3605 | 480 | 65885 | 2374 | 4D | S3A | 2N | 9008 |
| * 0202063 | 3130 | 114 | 9353 | 2174 | 3W | S3A | 3B | 9008 |
| * 0202063 | 3130 | 114 | 9353 | 2174 | 3W | S3A | 3B | 9008 |
| * 0202063 | 3131 | 115 | 9353 | 2174 | 3W | S3B | 3B | 9008 |
| * 0202063 | 3131 | 115 | 9353 | 2474 | 7K | S3A | 3B | 9008 |
| * 0202071 | 3777 | 12 | 9298 | 2174 | 3W | S3A | 7C | 9008 |
| * 0202076 | 3834 | 119 | 9629 | 2174 | 3W | S3B | 3Q | 9008 |
| * 0202081 | 4727 | 369 | 9298 | 2174 | 3W | S3A | 4P | 9008 |
| * 0202086 | 2102 | 22 | 9539 | 2174 | 3W | S3A | 2S | 9008 |
| * 0202086 | 2102 | 22 | 9539 | 2174 | 3W | S3A | 2S | 9008 |
| * 0202089 | 4442 | 7 | 9298 | 2174 | 3W | S3A | 7J | 9008 |
| * 0202089 | 4442 | 7 | 9298 | 2474 | 7J | S3A | 7J | 9008 |
| * 0202090 | 3061 | 0 | 9646 | 2174 | 3W | S3A | 7C | 9008 |
| * 0202095 | 5650 | 45 | 9298 | 2174 | 3W | S3A | 7C | 9008 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202095 | 5651 | 46 | 9298 | 2174 | 3W | S3A | 7C | 9008 |
| * 0202098 | 4246 | 333 | 9381 | 2474 | 7K | S3A | 5Q | 9008 |
| * 0202113 | 4165 | 382 | 9263 | 2474 | 1Z | S3A | 5Q | 9008 |
| * 0202120 | 2985 | 65 | 9539 | 2174 | 4D | S3B | 5C | 9008 |
| * 0202120 | 2994 | 74 | 9629 | 2474 | 8P | S3B | 5C | 9008 |
| * 0202127 | 5830 | 246 | 9629 | 2474 | 1Z | S3B | 1Z | 9008 |
| * 0202128 | 4243 | 425 | 9646 | 2174 | 3W | S3A | 5C | 9008 |
| * 0202128 | 4243 | 425 | 9646 | 2174 | 3W | S3A | 5C | 9008 |
| * 0202155 | 4072 | 143 | 9572 | 2474 | 1Z | S3B | 7C | 9008 |
| * 0202172 | 4546 | 65 | 9539 | 2174 | 4D | S3B | 7C | 9008 |
| * 0202193 | 4035 | 1497 | 55600 | 2474 | 7D | S3B | 2N | 9008 |
| * 0202197 | 4967 | 506 | 9629 | 2174 | 3W | S3B | 7K | 9008 |
| * 0202198 | 5228 | 0 | 246 | 2475 | 6A |  | 1Z | 9008 |
| * 0202208 | 4649 | 25 | 9192 | 2174 | 3W | S3A | 6Q | 9008 |
| * 0202212 | 5063 | 576 | 9629 | 2474 | 7C | S3B | 7C | 9008 |
| * 0202213 | 5521 | 1316 | 9353 | 2474 | 6F | S3B | 1Z | 9008 |
| * 0202232 | 5412 | 1514 | 65885 | 2374 | 4D | S3A | 1Z | 9008 |
| * 0202233 | 5439 | 45 | 9298 | 2474 | 5D | S3A | 3T | 9008 |
| * 0202236 | 5812 | 1350 | 9539 | 2474 | 7J | S3B | 7D | 9008 |
| * 0202252 | 3466 | 579 | 9646 | 2174 | 3W | S3B | 7K | 9008 |
| * 0202269 | 3602 | 22 | 9539 | 2174 | 3W | S3A | 7C | 9008 |
| * 0202269 | 3602 | 22 | 9539 | 2174 | 3W | S3A | 7C | 9008 |
| * 0202274 | 3283 | 1126 | 9192 | 2174 | 3W | S3A | 7L | 9008 |
| * 0202279 | 4656 | 587 | 9298 | 2474 | 5G | S3A | 7D | 9008 |
| * 0202281 | 4929 | 1 | 9353 | 2174 | 4D | S3A | 3A | 9008 |
| * 0202281 | 4939 | 11 | 9629 | 2474 | 8P | S3B | 3A | 9008 |
| * 0202293 | 4668 | 34 | 9646 | 2174 | 3W | S3A | 1Z | 9008 |
| * 0202298 | 3903 | 197 | 9629 | 2174 | 3W | S3B | 2N | 9008 |
| * 0202313 | 3634 | 673 | 9539 | 2174 | 4D | S3B | 3Q | 9008 |
| * 0202331 | 3163 | 0 | 65885 | 2374 | 4A | S3B | 3A | 9008 |
| * 0202346 | 4314 | 19 | 9353 | 2474 | 5W | S3B | 7C | 9008 |
| * 0202363 | 4053 | 52 | 9646 | 2174 | 3W | S3A | 1Z | 9008 |
| * 0202377 | 3714 | 13 | 9539 | 2174 | 3W | S3A | 3Q | 9008 |
| * 0202397 | 2146 | 215 | 9226 | 2474 | 3T | S3B | 3Q | 9008 |
| * 0202423 | 4190 | 1357 | 9646 | 2174 | 3W | S3B | 6Q | 9008 |
| * 0202437 | 4948 | 313 | 52947 | 2474 | 6F | US3A | 5D | 9008 |
| * 0202443 | 4455 | 470 | 9646 | 2174 | 3W | S3A | 5C | 9008 |
| * 0201106 | 5799 | 960 | 9204 | 2174 | 3W | S3A | 5Q | 9009 |
| * 0202055 | 5387 | 11 | 52947 | 2474 | 1W | US3A | 7L | 9009 |
| * 0202086 | 2147 | 67 | 9539 | 2474 | 3T | S3B | 2S | 9009 |
| * 0202095 | 5651 | 46 | 9298 | 2174 | 3W | S3A | 7C | 9009 |
| * 0202136 | 4681 | 318 | 9646 | 2174 | 3W | S3A | 7C | 9009 |
| * 0202180 | 5340 | 23 | 9298 | 2174 | 3W | S3A | 7C | 9009 |
| * 0202186 | 4357 | 0 | 62876 | 2475 | 7C |  | 3D | 9009 |
| * 0202188 | 5474 | 1373 | 9298 | 2474 | 2N | S3A | 5C | 9009 |
| * 0202192 | 5059 | 1822 | 9539 | 2174 | 3W | S3A | 5C | 9009 |
| * 0202196 | 3590 | 420 | 9298 | 2174 | 3W | S3A | 3D | 9009 |
| * 0202208 | 4649 | 25 | 9192 | 2474 | 3R | S3A | 6Q | 9009 |
| * 0202224 | 5150 | 888 | 9204 | 2174 | 3W | S3A | 3Q | 9009 |
| * 0202243 | 4747 | 981 | 9539 | 2174 | 3W | S3B | 7C | 9009 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202302 | 5082 | 0 | 3362 | 2475 | 3E | | 1G | 9009 |
| * 0202303 | 4229 | 1626 | 9287 | 2474 | 7C | S3B | 5C | 9009 |
| * 0202322 | 4100 | 189 | 9353 | 2474 | 5Q | S3B | 7C | 9009 |
| * 0202323 | 4638 | 392 | 9353 | 2474 | 8P | S3B | 8C | 9009 |
| * 0202359 | 4736 | 355 | 52947 | 2474 | 8C | US3A | 7D | 9009 |
| * 0202377 | 3714 | 13 | 9539 | 2174 | 3W | S3A | 3Q | 9009 |
| * 0202381 | 2970 | 186 | 9192 | 2474 | 7D | S3A | 7K | 9009 |
| * 0202402 | 5047 | 20 | 9646 | 2174 | 3W | S3A | 3U | 9009 |
| * 0202402 | 5047 | 20 | 9646 | 2174 | 3W | S3A | 3U | 9009 |
| * 0202412 | 4606 | 1603 | 9539 | 2174 | 3W | S3A | 7K | 9009 |
| * 0202423 | 4200 | 1367 | 9539 | 2174 | 3W | S3B | 6Q | 9009 |
| * 0202444 | 4656 | 37 | 9353 | 2474 | 1Z | S3B | 7D | 9009 |
| * 0201106 | 5833 | 994 | 9204 | 2474 | 2N | S3A | 5Q | 9010 |
| * 0201119 | 5189 | 536 | 9646 | 2174 | 3W | S3B | 7C | 9010 |
| * 0201125 | 4496 | 570 | 9572 | 2474 | 7C | S3B | 3Q | 9010 |
| * 0202014 | 3339 | 1029 | 9539 | 2174 | 3W | S3A | 7E | 9010 |
| * 0202015 | 4350 | 1316 | 9629 | 2174 | 3W | S3B | 5C | 9010 |
| * 0202020 | 4258 | 1101 | 9263 | 2474 | 7C | S3A | 8C | 9010 |
| * 0202030 | 3846 | 279 | 9381 | 2474 | 1Z | S3A | 1Z | 9010 |
| * 0202038 | 3566 | 942 | 9298 | 2474 | 1Z | S3A | 7D | 9010 |
| * 0202043 | 5079 | 632 | 9263 | 2474 | 7C | S3A | 3D | 9010 |
| * 0202060 | 4917 | 0 | 3361 | 2475 | 4D | | 5C | 9010 |
| * 0202075 | 2865 | 1006 | 9298 | 2474 | 5C | S3A | 3T | 9010 |
| * 0202076 | 3834 | 119 | 9539 | 2474 | 7C | S3A | 3Q | 9010 |
| * 0202088 | 4524 | 608 | 9646 | 2174 | 3W | S3A | 1G | 9010 |
| * 0202096 | 2036 | 495 | 9287 | 2474 | 7C | S3B | 5C | 9010 |
| * 0202106 | 2374 | 0 | 9287 | 2474 | 7J | S3B | 7C | 9010 |
| * 0202108 | 4508 | 604 | 9353 | 2174 | 4D | S3B | 7D | 9010 |
| * 0202122 | 4950 | 814 | 9539 | 2474 | 5Q | S3B | 2N | 9010 |
| * 0202140 | 2564 | 393 | 65885 | 2374 | 4D | S3A | 7C | 9010 |
| * 0202146 | 3518 | 892 | 9381 | 2474 | 5Q | S3A | 2N | 9010 |
| * 0202260 | 5618 | 1175 | 9539 | 2474 | 8C | S3B | 7C | 9010 |
| * 0202263 | 5242 | 486 | 9192 | 2474 | 7C | S3A | 3Q | 9010 |
| * 0202276 | 4659 | 181 | 9572 | 2174 | 3W | S3B | 7C | 9010 |
| * 0202300 | 3799 | 705 | 9572 | 2174 | 3W | S3B | 2S | 9010 |
| * 0202305 | 4349 | 391 | 9287 | 2474 | 3Q | S3B | 6F | 9010 |
| * 0202336 | 5140 | 364 | 9572 | 2474 | 7C | S3B | 2N | 9010 |
| * 0202338 | 3987 | 309 | 9381 | 2474 | 8C | S3A | 7K | 9010 |
| * 0202354 | 4883 | 1450 | 65885 | 2374 | 4D | S3A | 6F | 9010 |
| * 0202369 | 4631 | 367 | 9646 | 2174 | 3W | S3A | 3Q | 9010 |
| * 0202417 | 5052 | 246 | 9539 | 2174 | 3W | S3A | 3A | 9010 |
| * 0201022 | 3155 | 79 | 9353 | 2174 | 3W | S3B | 3Q | 9011 |
| * 0201108 | 4576 | 185 | 9298 | 2174 | 3W | S3A | 2S | 9011 |
| * 0201121 | 2591 | 1101 | 9539 | 2174 | 3W | S3B | 4M | 9011 |
| * 0201123 | 4723 | 180 | 9353 | 2174 | 3W | S3B | 7C | 9011 |
| * 0202001 | 4095 | 366 | 9646 | 2174 | 3W | S3A | 6F | 9011 |
| * 0202003 | 4538 | 822 | 9629 | 2474 | 1G | S3B | 5C | 9011 |
| * 0202007 | 1892 | 114 | 9646 | 2174 | 3W | S3B | 7C | 9011 |
| * 0202007 | 1892 | 114 | 9539 | 2174 | 4D | S3A | 7C | 9011 |
| * 0202011 | 3690 | 522 | 55600 | 2474 | 5G | S3B | 7C | 9011 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202036 | 6665 | 532 | 9381 | 2474 | 7D | S3A | 3Q | 9011 |
| * 0202060 | 4917 | 0 | 9192 | 2174 | 3W | S3A | 6A | 9011 |
| * 0202087 | 4339 | 1285 | 9629 | 2174 | 4D | S3B | 7K | 9011 |
| * 0202113 | 4249 | 84 | 9192 | 2174 | 3W | S3A | 1Z | 9011 |
| * 0202121 | 5687 | 171 | 9646 | 2174 | 3W | S3B | 7C | 9011 |
| * 0202126 | 5621 | 1546 | 9192 | 2174 | 3W | S3A | 3T | 9011 |
| * 0202128 | 4364 | 546 | 9539 | 2174 | 3W | S3B | 5C | 9011 |
| * 0202136 | 4733 | 370 | 9646 | 2474 | 7C | S3A | 7C | 9011 |
| * 0202140 | 2564 | 393 | 65885 | 3372 | 3A | | 7C | 9011 |
| * 0202141 | 4328 | 13 | 9646 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202153 | 4666 | 1 | 9263 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202155 | 4072 | 0 | 9646 | 2174 | 3W | S3A | 1Z | 9011 |
| * 0202163 | 3015 | 558 | 9298 | 2474 | 5G | S3A | 7C | 9011 |
| * 0202167 | 3654 | 569 | 9263 | 2174 | 3W | S3A | 5Q | 9011 |
| * 0202171 | 4352 | 170 | 9263 | 2174 | 3W | S3A | 3A | 9011 |
| * 0202174 | 5921 | 1284 | 9192 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202174 | 5921 | 1284 | 9192 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202188 | 5484 | 10 | 9192 | 2174 | 3W | S3A | 2N | 9011 |
| * 0202210 | 3581 | 457 | 9263 | 2174 | 3W | S3A | 5G | 9011 |
| * 0202225 | 5875 | 2357 | 9353 | 2174 | 3W | S3B | 7K | 9011 |
| * 0202229 | 4041 | 170 | 9204 | 2174 | 3W | S3A | 5Q | 9011 |
| * 0202281 | 5004 | 65 | 9646 | 2174 | 3W | S3A | 6A | 9011 |
| * 0202285 | 4423 | 271 | 9204 | 2174 | 3W | S3A | 1Z | 9011 |
| * 0202293 | 4760 | 126 | 9646 | 2174 | 3W | S3A | 1Z | 9011 |
| * 0202306 | 3756 | 373 | 9539 | 2174 | 3W | S3B | 1Z | 9011 |
| * 0202309 | 4347 | 574 | 9646 | 2174 | 3W | S3B | 5B | 9011 |
| * 0202315 | 4097 | 357 | 9353 | 2474 | 3T | S3B | 7C | 9011 |
| * 0202322 | 4141 | 41 | 9353 | 2174 | 3W | S3B | 5Q | 9011 |
| * 0202324 | 4443 | 457 | 9646 | 2174 | 3W | S3B | 3Q | 9011 |
| * 0202330 | 5157 | 662 | 9192 | 2474 | 1Z | S3A | 7C | 9011 |
| * 0202344 | 5154 | 663 | 9298 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202347 | 3610 | 492 | 9539 | 2474 | 2N | S3A | 7C | 9011 |
| * 0202354 | 4883 | 1450 | 65885 | 3372 | 1Z | | 6F | 9011 |
| * 0202363 | 4145 | 144 | 9646 | 2174 | 3W | S3A | 1Z | 9011 |
| * 0202368 | 4080 | 390 | 9263 | 2174 | 3W | S3A | 5C | 9011 |
| * 0202369 | 4700 | 436 | 9646 | 2174 | 3W | S3B | 3Q | 9011 |
| * 0202378 | 4138 | 0 | 9263 | 2174 | 3W | S3A | 3Q | 9011 |
| * 0202384 | 4406 | 994 | 9646 | 2174 | 3W | S3B | 1Z | 9011 |
| * 0202386 | 4551 | 12 | 9263 | 2174 | 3W | S3A | 4B | 9011 |
| * 0202388 | 3845 | 359 | 65885 | 2374 | 4D | S3A | 2N | 9011 |
| * 0202391 | 3328 | 170 | 9263 | 2174 | 3W | S3A | 3Q | 9011 |
| * 0202395 | 4837 | 778 | 9192 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202398 | 4618 | 1496 | 9263 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202401 | 4577 | 410 | 9353 | 2174 | 4D | S3B | 3A | 9011 |
| * 0202423 | 4232 | 1399 | 9539 | 2474 | 5C | S3B | 6Q | 9011 |
| * 0202424 | 4003 | 520 | 9298 | 2174 | 3W | S3A | 7C | 9011 |
| * 0202439 | 4552 | 149 | 65885 | 2374 | 4D | S3A | 3Q | 9011 |
| * 0202444 | 4656 | 0 | 9646 | 2174 | 3W | S3A | 1Z | 9011 |
| * 0201103 | 5428 | 1018 | 9287 | 2474 | 3D | S3B | 1Z | 9012 |
| * 0201111 | 5268 | 919 | 9572 | 2474 | 7C | S3B | 7C | 9012 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0201116 | 4874 | 388 | 9646 | 2174 | 3W | S3B | 3W | 9012 |
| * 0201120 | 5041 | 0 | 65885 | 2374 | 4D | S3B | 4A | 9012 |
| * 0201124 | 1986 | 585 | 9263 | 2174 | 3W | S3A | 3Q | 9012 |
| * 0202013 | 4997 | 526 | 9263 | 2174 | 3W | S3A | 7C | 9012 |
| * 0202023 | 4757 | 770 | 9192 | 2474 | 3P | S3A | 1Z | 9012 |
| * 0202040 | 4456 | 283 | 9263 | 2174 | 3W | S3A | 7C | 9012 |
| * 0202047 | 3152 | 1255 | 9263 | 2174 | 3W | S3A | 5W | 9012 |
| * 0202091 | 4062 | 168 | 9263 | 2474 | 1Z | S3A | 7D | 9012 |
| * 0202103 | 2385 | 1401 | 9263 | 2174 | 3W | S3A | | 9012 |
| * 0202109 | 3848 | 59 | 63282 | 3372 | 6A | | 2N | 9012 |
| * 0202145 | 3508 | 372 | 9629 | 2174 | 4D | S3B | 5C | 9012 |
| * 0202166 | 3687 | 450 | 9353 | 2174 | 4D | S3B | 7C | 9012 |
| * 0202169 | 4625 | 114 | 421 | 2474 | 1Z | S3A | 5Q | 9012 |
| * 0202173 | 3010 | 1030 | 9539 | 2474 | 5Q | S3B | 2C | 9012 |
| * 0202180 | 5384 | 67 | 65885 | 2374 | 4D | S3A | 7C | 9012 |
| * 0202199 | 6253 | 1206 | 9539 | 2474 | 7C | S3B | 1Z | 9012 |
| * 0202203 | 3495 | 47 | 9353 | 2174 | 4D | S3B | 1Z | 9012 |
| * 0202203 | 3495 | 47 | 9539 | 2174 | 3W | S3B | 1Z | 9012 |
| * 0202204 | 5260 | 804 | 9739 | 2474 | 5B | S3B | 2S | 9012 |
| * 0202205 | 4933 | 914 | 65885 | 2374 | 4D | S3A | 5G | 9012 |
| * 0202215 | 4209 | 749 | 9739 | 2174 | 3W | S3A | 3T | 9012 |
| * 0202220 | 3029 | 116 | 9287 | 2474 | 3M | S3B | 1Z | 9012 |
| * 0202224 | 5164 | 902 | 65885 | 2374 | 4D | S3A | 3Q | 9012 |
| * 0202225 | 5876 | 2358 | 9739 | 2174 | 3W | S3B | 7K | 9012 |
| * 0202225 | 5877 | 2359 | 9739 | 2174 | 3W | S3A | 7K | 9012 |
| * 0202231 | 4847 | 1175 | 9539 | 2174 | 3W | S3A | 7K | 9012 |
| * 0202234 | 3815 | 190 | 9192 | 2474 | 1Z | S3A | 1Z | 9012 |
| * 0202237 | 4785 | 315 | 9204 | 2174 | 3W | S3A | 2S | 9012 |
| * 0202239 | 4367 | 896 | 9739 | 2474 | 5W | S3A | 5C | 9012 |
| * 0202250 | 4946 | 733 | 52947 | 2474 | 5Q | US3A | 7C | 9012 |
| * 0202254 | 5772 | 1476 | 9204 | 2474 | 7C | S3A | 5C | 9012 |
| * 0202293 | 4782 | 148 | 9539 | 2174 | 4D | S3A | 1Z | 9012 |
| * 0202293 | 4788 | 154 | 9353 | 2474 | 1Z | S3B | 1Z | 9012 |
| * 0202298 | 4166 | 460 | 9629 | 2174 | 3W | S3B | 2N | 9012 |
| * 0202310 | 4501 | 1457 | 9629 | 2174 | 4D | S3B | 1W | 9012 |
| * 0202324 | 4443 | 457 | 9539 | 2174 | 3W | S3A | 3Q | 9012 |
| * 0202332 | 4780 | 542 | 9263 | 2174 | 3W | S3A | 5G | 9012 |
| * 0202355 | 4775 | 284 | 9263 | 2174 | 3W | S3A | 3Q | 9012 |
| * 0202363 | 4280 | 279 | 9646 | 2474 | 7K | S3B | 1Z | 9012 |
| * 0202370 | 5368 | 618 | 52947 | 2474 | 3T | US3A | 6F | 9012 |
| * 0202391 | 3328 | 170 | 9263 | 2174 | 3W | S3A | 3Q | 9012 |
| * 0202406 | 3358 | 553 | 9353 | 2174 | 3W | S3B | 5C | 9012 |
| * 0202407 | 5113 | 821 | 9539 | 2474 | 7C | S3B | 7C | 9012 |
| * 0202420 | 4799 | 394 | 9572 | 2174 | 4D | S3B | 3Q | 9012 |
| * 0202434 | 3357 | 141 | 63282 | 3372 | 6A | | 7C | 9012 |
| * 0202434 | 3357 | 141 | 63282 | 2374 | 4D | S3A | 7C | 9012 |
| * 0202439 | 4552 | 149 | 65885 | 3372 | 1Z | | 3Q | 9012 |
| * 0201120 | 5041 | 0 | 65885 | 3372 | 6Q | | 4A | 9101 |
| * 0202025 | 5229 | 954 | 9298 | 2474 | 5C | S3A | 1Z | 9101 |
| * 0202051 | 3605 | 480 | 65885 | 3372 | 3A | | 2N | 9101 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202052 | 4450 | 539 | 9381 | 2174 | 3W | S3A | 7C | 9101 |
| * 0202080 | 5843 | 360 | 9226 | 2474 | 7C | S3B | 6P | 9101 |
| * 0202090 | 3437 | 376 | 9629 | 2474 | 1Z | S3B | 7C | 9101 |
| * 0202095 | 5694 | 89 | 65885 | 2374 | 4D | S3A | 7C | 9101 |
| * 0202095 | 5694 | 89 | 65885 | 3372 | 1Z | | 7C | 9101 |
| * 0202134 | 5203 | 1115 | 9226 | 2474 | 3Q | S3B | 7K | 9101 |
| * 0202149 | 4595 | 0 | 3367 | 2475 | 3W | | 2S | 9101 |
| * 0202156 | 6360 | 1629 | 9539 | 2474 | 7C | S3B | 5C | 9101 |
| * 0202183 | 5548 | 1354 | 9572 | 2174 | 4D | S3B | 5C | 9101 |
| * 0202203 | 3495 | 47 | 9539 | 2474 | 5W | S3B | 1Z | 9101 |
| * 0202205 | 4933 | 914 | 65885 | 3372 | 1Z | | 5G | 9101 |
| * 0202224 | 5164 | 902 | 65885 | 3372 | 1Z | | 3Q | 9101 |
| * 0202232 | 5412 | 1514 | 65885 | 3372 | 3A | | 1Z | 9101 |
| * 0202235 | 5045 | 832 | 52947 | 2474 | 2S | US3A | 3R | 9101 |
| * 0202252 | 3592 | 705 | 9539 | 2174 | 3W | S3A | 7K | 9101 |
| * 0202288 | 4124 | 847 | 421 | 2174 | 3W | S3B | 5G | 9101 |
| * 0202300 | 3956 | 862 | 9572 | 2474 | 1Z | S3B | 2S | 9101 |
| * 0202304 | 3436 | 132 | 65885 | 2374 | 4D | S3B | 7C | 9101 |
| * 0202340 | 4595 | 227 | 52947 | 2474 | 5W | US3A | 5C | 9101 |
| * 0202342 | 2827 | 2 | 52947 | 2474 | 7K | US3A | 6T | 9101 |
| * 0202346 | 4315 | 1 | 9539 | 2474 | 5W | S3B | 5W | 9101 |
| * 0202356 | 4791 | 133 | 9381 | 2174 | 3W | S3A | 6Q | 9101 |
| * 0202359 | 4748 | 12 | 52947 | 2474 | 3T | US3A | 5D | 9101 |
| * 0202412 | 4616 | 1613 | 65885 | 2374 | 4D | S3B | 7K | 9101 |
| * 0202444 | 4660 | 4 | 9646 | 2474 | 1Z | S3B | 1Z | 9101 |
| * 0201021 | 3840 | 481 | 9572 | 2174 | 4D | S3B | 1Z | 9102 |
| * 0201104 | 5166 | 0 | 3361 | 2475 | 3W | | 3A | 9102 |
| * 0201111 | 5281 | 13 | 9572 | 2174 | 3W | S3B | 7C | 9102 |
| * 0202002 | 4454 | 494 | 65885 | 2374 | 4D | S3A | 6P | 9102 |
| * 0202009 | 4979 | 134 | 9539 | 2174 | 3W | S3B | 7C | 9102 |
| * 0202025 | 5229 | 0 | 246 | 2475 | 3R | | 5D | 9102 |
| * 0202035 | 3213 | 595 | 9192 | 2474 | 3U | S3A | 7C | 9102 |
| * 0202069 | 5071 | 458 | 52947 | 2174 | 3W | US3A | 7L | 9102 |
| * 0202126 | 5637 | 1562 | 9204 | 2474 | 5G | S3A | 3T | 9102 |
| * 0202127 | 5990 | 160 | 9629 | 2474 | 3Q | S3B | 1Z | 9102 |
| * 0202128 | 4375 | 557 | 65885 | 2374 | 4D | S3B | 5C | 9102 |
| * 0202130 | 5239 | 681 | 9572 | 2474 | 1Z | S3B | 3T | 9102 |
| * 0202131 | 5131 | 591 | 9226 | 2474 | 7C | S3B | 2S | 9102 |
| * 0202133 | 3777 | 560 | 65885 | 2374 | 4D | S3A | 3R | 9102 |
| * 0202133 | 3777 | 560 | 65885 | 3372 | 1Z | | 3R | 9102 |
| * 0202141 | 4543 | 228 | 9646 | 2174 | 4D | S3B | 7C | 9102 |
| * 0202142 | 5726 | 850 | 9646 | 2474 | 2N | S3B | 8F | 9102 |
| * 0202161 | 4854 | 339 | 9646 | 2174 | 3W | S3B | 1Z | 9102 |
| * 0202166 | 3759 | 522 | 9572 | 2474 | 7C | S3B | 7C | 9102 |
| * 0202181 | 5997 | 1513 | 9539 | 2474 | 5Q | S3B | 7C | 9102 |
| * 0202222 | 5709 | 383 | 9298 | 2174 | 3W | S3A | 2F | 9102 |
| * 0202243 | 4873 | 1107 | 9539 | 2174 | 4D | S3A | 7C | 9102 |
| * 0202269 | 3912 | 332 | 9539 | 2474 | 5Q | S3B | 7C | 9102 |
| * 0202283 | 3718 | 570 | 9287 | 2474 | 2S | S3B | 7C | 9102 |
| * 0202290 | 4214 | 422 | 9539 | 2474 | 3R | S3B | 7D | 9102 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202327 | 6096 | 1484 | 52947 | 2474 | 7C | US3A | 3D | 9102 |
| * 0202358 | 4897 | 752 | 9287 | 2474 | 7C | S3B | 7K | 9102 |
| * 0202376 | 5247 | 1278 | 9226 | 2474 | 7C | S3B | 2N | 9102 |
| * 0202384 | 4428 | 1016 | 9539 | 2174 | 3W | S3A | 1Z | 9102 |
| * 0202398 | 4720 | 1598 | 9298 | 2474 | 3R | S3A | 7C | 9102 |
| * 0202404 | 5064 | 509 | 9629 | 2474 | 5B | S3B | 7C | 9102 |
| * 0202412 | 4616 | 1613 | 65885 | 3372 | 3A | | 7K | 9102 |
| * 0202427 | 4540 | 345 | 9646 | 2474 | 2N | S3B | 1Z | 9102 |
| * 0202437 | 5018 | 70 | 52947 | 2474 | 3R | US3A | 6F | 9102 |
| * 0201021 | 3870 | 511 | 9539 | 2174 | 3W | S3B | 1Z | 9103 |
| * 0201113 | 5335 | 22 | 9539 | 2474 | 2N | S3B | 1Z | 9103 |
| * 0201116 | 5021 | 535 | 9539 | 2174 | 3W | S3B | 3W | 9103 |
| * 0201123 | 4878 | 335 | 9539 | 2174 | 3W | S3B | 7C | 9103 |
| * 0202015 | 4361 | 1327 | 65885 | 2374 | 4D | S3B | 5C | 9103 |
| * 0202024 | 4711 | 732 | 52947 | 2474 | 7C | US3A | 1W | 9103 |
| * 0202046 | 5930 | 1157 | 52947 | 2474 | 7C | US3A | 7D | 9103 |
| * 0202054 | 3511 | 162 | 65885 | 2374 | 4D | US3A | 6F | 9103 |
| * 0202060 | 5339 | 422 | 9192 | 2474 | 3R | S3A | 6A | 9103 |
| * 0202063 | 3136 | 5 | 9629 | 2474 | 8C | S3B | 7K | 9103 |
| * 0202068 | 4583 | 136 | 9539 | 2174 | 3W | S3A | 7C | 9103 |
| * 0202087 | 4339 | 1285 | 9539 | 2474 | 5Q | S3A | 7K | 9103 |
| * 0202091 | 4062 | 168 | 9298 | 2474 | 5C | S3A | 7D | 9103 |
| * 0202101 | 4457 | 131 | 9353 | 2174 | 3W | S3B | 3A | 9103 |
| * 0202118 | 4954 | 147 | 9629 | 2174 | 3W | S3B | 7C | 9103 |
| * 0202128 | 4375 | 557 | 65885 | 3372 | 1Z | | 5C | 9103 |
| * 0202145 | 3514 | 378 | 9539 | 2174 | 3W | S3A | 5C | 9103 |
| * 0202225 | 6032 | 2514 | 9539 | 2174 | 3W | S3B | 7K | 9103 |
| * 0202227 | 5467 | 958 | 9629 | 2474 | 1Z | S3B | 7H | 9103 |
| * 0202250 | 5015 | 69 | 52947 | 2474 | 5Q | US3A | 5Q | 9103 |
| * 0202256 | 5042 | 1619 | 9192 | 2474 | 7C | S3A | 5C | 9103 |
| * 0202296 | 5268 | 778 | 9287 | 2474 | 5B | S3B | 4P | 9103 |
| * 0202298 | 4172 | 466 | 9539 | 2174 | 3W | S3A | 2N | 9103 |
| * 0202306 | 3911 | 528 | 9539 | 2174 | 3W | S3A | 1Z | 9103 |
| * 0202312 | 3465 | 216 | 9629 | 2474 | 6Q | S3B | 7C | 9103 |
| * 0202340 | 4615 | 20 | 52947 | 2474 | 2P | US3A | 5W | 9103 |
| * 0202344 | 5253 | 762 | 9298 | 2474 | 5G | S3A | 7C | 9103 |
| * 0202419 | 2194 | 273 | 65885 | 2374 | 4D | US3A | 1W | 9103 |
| * 0201121 | 2740 | 1250 | 9539 | 2174 | 3W | S3B | 4M | 9104 |
| * 0201123 | 4930 | 387 | 9539 | 2174 | 3W | S3B | 7C | 9104 |
| * 0202015 | 4361 | 1327 | 65885 | 3372 | 3A | | 5C | 9104 |
| * 0202016 | 5204 | 297 | 9204 | 2174 | 3W | S3A | 3R | 9104 |
| * 0202020 | 4278 | 20 | 9204 | 2174 | 3W | S3A | 7C | 9104 |
| * 0202049 | 5456 | 260 | 9539 | 2174 | 3W | S3B | 6A | 9104 |
| * 0202062 | 5011 | 547 | 9539 | 2174 | 3W | S3B | 2N | 9104 |
| * 0202065 | 2654 | 559 | 9572 | 2474 | 7C | S3B | 5C | 9104 |
| * 0202096 | 2036 | 0 | 60200 | 2475 | 3B | | 7C | 9104 |
| * 0202097 | 4004 | 1283 | 9204 | 2174 | 3W | S3A | 7C | 9104 |
| * 0202116 | 4513 | 478 | 9572 | 2474 | 7C | S3B | 2N | 9104 |
| * 0202125 | 6036 | 234 | 9204 | 2174 | 3W | S3A | 7L | 9104 |
| * 0202129 | 5267 | 1477 | 9204 | 2174 | 3W | S3A | 3W | 9104 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202174 | 5997 | 1360 | 9298 | 2474 | 5C | S3A | 7C | 9104 |
| * 0202179 | 4100 | 836 | 9629 | 2474 | 7C | S3B | 7C | 9104 |
| * 0202198 | 5265 | 37 | 65885 | 2374 | 4D | S3A | 6A | 9104 |
| * 0202209 | 4521 | 0 | 9192 | 2474 | 3R | S3A | 6P | 9104 |
| * 0202214 | 4983 | 11 | 9298 | 2174 | 3W | S3A | 7D | 9104 |
| * 0202217 | 5282 | 323 | 9298 | 2474 | 6J | S3A | 7C | 9104 |
| * 0202226 | 3455 | 50 | 9739 | 2174 | 3W | S3A | 3A | 9104 |
| * 0202234 | 3815 | 0 | 21297 | 2475 | 3W | | 1Z | 9104 |
| * 0202242 | 4784 | 1606 | 9287 | 2474 | 7C | S3B | 4D | 9104 |
| * 0202253 | 5564 | 669 | 9739 | 2174 | 3W | S3B | 3M | 9104 |
| * 0202264 | 4124 | 78 | 9646 | 2474 | 3Q | S3B | 3B | 9104 |
| * 0202266 | 3557 | 339 | 9629 | 2474 | 1G | S3B | 3B | 9104 |
| * 0202278 | 5485 | 15 | 9629 | 2474 | 8F | S3B | 3Q | 9104 |
| * 0202320 | 2853 | 979 | 9204 | 2174 | 3W | S3A | 3D | 9104 |
| * 0202336 | 5155 | 15 | 9629 | 2474 | 3Q | S3B | 7C | 9104 |
| * 0202364 | 5343 | 1084 | 9298 | 2474 | 6J | S3A | 2N | 9104 |
| * 0202365 | 6022 | 745 | 9298 | 2474 | 6J | S3A | 8C | 9104 |
| * 0202367 | 4201 | 83 | 52947 | 2474 | 1G | US3A | 8C | 9104 |
| * 0202377 | 4178 | 477 | 9539 | 2474 | 3P | S3B | 3Q | 9104 |
| * 0202381 | 2978 | 8 | 65885 | 2374 | 4D | S3A | 7C | 9104 |
| * 0202383 | 4497 | 9 | 52947 | 2474 | 6F | US3A | 1Z | 9104 |
| * 0202420 | 4899 | 494 | 9353 | 2474 | 6F | S3B | 3Q | 9104 |
| * 0202432 | 4527 | 1379 | 9226 | 2474 | 3Q | S3B | 5D | 9104 |
| * 0201102 | 5200 | 52 | 9739 | 2174 | 3W | S3A | 4M | 9105 |
| * 0202024 | 4778 | 67 | 52947 | 2474 | 3D | US3A | 7D | 9105 |
| * 0202052 | 4458 | 547 | 9381 | 2174 | 3W | S3A | 7C | 9105 |
| * 0202053 | 5762 | 761 | 9287 | 2474 | 3Q | S3B | 7C | 9105 |
| * 0202070 | 4387 | 289 | 9226 | 2474 | 7C | S3B | 7C | 9105 |
| * 0202071 | 3941 | 176 | 9204 | 2174 | 3W | S3A | 7C | 9105 |
| * 0202111 | 4476 | 247 | 9204 | 2174 | 3W | S3A | 7C | 9105 |
| * 0202117 | 3939 | 1042 | 9226 | 2474 | 5Q | S3B | 1W | 9105 |
| * 0202137 | 4848 | 115 | 65885 | 2374 | 4D | S3B | 1Z | 9105 |
| * 0202137 | 4848 | 115 | 65885 | 3372 | 5W | | 1Z | 9105 |
| * 0202141 | 4557 | 242 | 9539 | 2474 | 6F | S3A | 7C | 9105 |
| * 0202195 | 3888 | 511 | 9298 | 2474 | 7C | S3A | 1Z | 9105 |
| * 0202202 | 5197 | 161 | 9381 | 2174 | 3W | S3A | 7C | 9105 |
| * 0202219 | 4845 | 776 | 9739 | 2174 | 3W | S3B | 5G | 9105 |
| * 0202231 | 4851 | 1179 | 65885 | 2374 | 4D | S3B | 7K | 9105 |
| * 0202231 | 4851 | 1179 | 65885 | 3372 | 3A | | 7K | 9105 |
| * 0202233 | 5634 | 195 | 9204 | 2474 | 8C | S3A | 3Q | 9105 |
| * 0202251 | 2492 | 1056 | 9226 | 2474 | 4B | S3B | 2S | 9105 |
| * 0202287 | 3890 | 1162 | 9298 | 2474 | 7C | S3A | 3Q | 9105 |
| * 0202289 | 4836 | 1072 | 9226 | 2474 | 4B | S3B | 4P | 9105 |
| * 0202313 | 4347 | 1386 | 9629 | 2474 | 7C | S3B | 3Q | 9105 |
| * 0202357 | 2673 | 558 | 9226 | 2474 | 7C | S3B | 7C | 9105 |
| * 0202361 | 4074 | 779 | 9226 | 2174 | 3W | S3B | 7K | 9105 |
| * 0202391 | 3575 | 417 | 9263 | 2474 | 4P | S3A | 3Q | 9105 |
| * 0202401 | 4777 | 610 | 9572 | 2474 | 7C | S3B | 3A | 9105 |
| * 0202416 | 3534 | 701 | 9381 | 2174 | 3W | S3A | 3Q | 9105 |
| * 0202431 | 3949 | 441 | 9739 | 2474 | 1G | S3B | 5G | 9105 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202441 | 5383 | 584 | 9381 | 2174 | 3W | S3A | 5Q | 9105 |
| * 0201102 | 5236 | 88 | 9739 | 2474 | 1Z | S3B | 4M | 9106 |
| * 0201110 | 5431 | 1030 | 9353 | 2474 | 8B | S3B | 7C | 9106 |
| * 0201116 | 5034 | 548 | 65885 | 2374 | 7H | S3A | 3W | 9106 |
| * 0201116 | 5034 | 548 | 65885 | 3372 | 7C | | 3W | 9106 |
| * 0201119 | 5247 | 594 | 9287 | 2474 | 7C | S3A | 7C | 9106 |
| * 0201123 | 4946 | 403 | 65885 | 2374 | 4D | S3B | 7C | 9106 |
| * 0201124 | 2360 | 959 | 9263 | 2474 | 1G | S3A | 3Q | 9106 |
| * 0202062 | 5027 | 563 | 65885 | 2374 | 4D | S3B | 2N | 9106 |
| * 0202062 | 5027 | 563 | 65885 | 3372 | 3A | | 2N | 9106 |
| * 0202069 | 5284 | 671 | 52947 | 2474 | 7C | US3A | 7L | 9106 |
| * 0202092 | 3475 | 228 | 9629 | 2474 | 1G | S3B | 5C | 9106 |
| * 0202102 | 4775 | 48 | 421 | 2174 | 3W | S3B | 3A | 9106 |
| * 0202108 | 4566 | 662 | 9287 | 2474 | 7C | S3A | 7D | 9106 |
| * 0202114 | 3925 | 366 | 421 | 2174 | 3W | S3A | 7C | 9106 |
| * 0202160 | 4784 | 567 | 9353 | 2474 | 8P | S3B | 7C | 9106 |
| * 0202166 | 4009 | 250 | 9539 | 2474 | 3Q | S3B | 7C | 9106 |
| * 0202178 | 5254 | 1062 | 9381 | 2474 | 5C | S3A | 4D | 9106 |
| * 0202225 | 6148 | 2630 | 9539 | 2474 | 7C | S3B | 7K | 9106 |
| * 0202237 | 5241 | 771 | 9192 | 2474 | 7C | S3A | 2S | 9106 |
| * 0202245 | 4275 | 49 | 421 | 2174 | 3W | S3B | 2S | 9106 |
| * 0202268 | 5239 | 811 | 9739 | 2174 | 3W | S3B | 3R | 9106 |
| * 0202329 | 5777 | 687 | 9739 | 2174 | 3W | S3B | 7D | 9106 |
| * 0202350 | 4914 | 300 | 9353 | 2174 | 3W | S3B | 3Q | 9106 |
| * 0202360 | 3546 | 0 | 3369 | 2475 | 3W | | 3R | 9106 |
| * 0202366 | 4648 | 220 | 9298 | 2174 | 3W | S3A | 3Q | 9106 |
| * 0202380 | 5144 | 428 | 9298 | 2474 | 8P | S3A | 1Z | 9106 |
| * 0202415 | 4755 | 435 | 9646 | 2474 | 6C | S3B | 1Z | 9106 |
| * 0202424 | 4268 | 785 | 9298 | 2474 | 9C | S3A | 7C | 9106 |
| * 0202428 | 3408 | 289 | 9381 | 2174 | 3W | S3A | 3Q | 9106 |
| * 0201111 | 5539 | 271 | 9572 | 2474 | 7A | S3B | 7C | 9107 |
| * 0201119 | 5247 | 0 | 9353 | 2474 | 1G | S3B | 7C | 9107 |
| * 0202008 | 3505 | 51 | 9646 | 2474 | 3Q | S3B | 1Z | 9107 |
| * 0202023 | 4851 | 94 | 52947 | 2174 | 3W | US3A | 3P | 9107 |
| * 0202036 | 6666 | 1 | 52947 | 2474 | 5Q | US3A | 7D | 9107 |
| * 0202047 | 3159 | 1262 | 65885 | 2374 | 4D | S3A | 5W | 9107 |
| * 0202074 | 4213 | 655 | 9353 | 2174 | 3W | S3B | 2N | 9107 |
| * 0202097 | 4043 | 1322 | 9345 | 2474 | 7C | S3A | 7C | 9107 |
| * 0202103 | 2392 | 1408 | 65885 | 2374 | 4D | S3A | | 9107 |
| * 0202106 | 2867 | 493 | 9287 | 2474 | 5Q | S3B | 3B | 9107 |
| * 0202107 | 1305 | 32 | 246 | 2475 | 6K | | 3R | 9107 |
| * 0202129 | 5307 | 1517 | 9345 | 2474 | 7C | S3A | 3W | 9107 |
| * 0202171 | 4660 | 478 | 9263 | 2474 | 7K | S3A | 3A | 9107 |
| * 0202172 | 5388 | 907 | 9629 | 2474 | 7C | S3B | 7C | 9107 |
| * 0202186 | 4361 | 4 | 52947 | 2474 | 5Q | US3A | 7C | 9107 |
| * 0202257 | 6001 | 1034 | 9287 | 2474 | 7C | S3B | 7C | 9107 |
| * 0202308 | 4269 | 0 | 68539 | 2475 | 2Q | | 2C | 9107 |
| * 0202377 | 4178 | 0 | 9353 | 2474 | 7K | S3B | 3P | 9107 |
| * 0201103 | 5431 | 3 | 9539 | 2474 | 5Q | S3B | 3D | 9108 |
| * 0201104 | 5327 | 161 | 9192 | 2474 | 6N | S3A | 3W | 9108 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0201121 | 2913 | 1423 | 9539 | 2474 | 5Q | S3B | 4M | 9108 |
| * 0202005 | 5212 | 450 | 9298 | 2474 | 3Q | S3A | 1Z | 9108 |
| * 0202009 | 5251 | 406 | 9539 | 2474 | 1G | S3B | 7C | 9108 |
| * 0202009 | 5251 | 0 | 9287 | 2474 | 2N | S3B | 1G | 9108 |
| * 0202029 | 5096 | 562 | 9298 | 2174 | 3W | S3A | 7C | 9108 |
| * 0202041 | 3833 | 358 | 9192 | 2174 | 3W | S3A | 3Q | 9108 |
| * 0202049 | 5468 | 272 | 9539 | 2474 | 5Q | S3A | 6A | 9108 |
| * 0202160 | 4818 | 34 | 9353 | 2474 | 3T | S3B | 5W | 9108 |
| * 0202188 | 6122 | 648 | 9192 | 2474 | 1Z | S3A | 2N | 9108 |
| * 0202189 | 4628 | 1605 | 9345 | 2474 | 7C | S3A | 7D | 9108 |
| * 0202261 | 5432 | 407 | 9572 | 2174 | 3W | S3B | 2S | 9108 |
| * 0202264 | 4124 | 0 | 9226 | 2174 | 3W | S3B | 3Q | 9108 |
| * 0202267 | 5742 | 0 | 9226 | 2174 | 4D | S3B | 6P | 9108 |
| * 0202267 | 5753 | 11 | 9353 | 2474 | 7K | S3B | 6P | 9108 |
| * 0202271 | 5990 | 199 | 9629 | 2474 | 5Q | S3B | 5C | 9108 |
| * 0202272 | 4305 | 410 | 9572 | 2174 | 3W | S3B | 6F | 9108 |
| * 0202274 | 3439 | 1282 | 65885 | 2374 | 4D | S3A | 7L | 9108 |
| * 0202290 | 4369 | 155 | 9572 | 2174 | 3W | S3B | 3R | 9108 |
| * 0202292 | 5730 | 1630 | 9287 | 2474 | 7C | S3B | 5Q | 9108 |
| * 0202306 | 3921 | 538 | 9539 | 2174 | 3W | S3B | 1Z | 9108 |
| * 0202306 | 3921 | 538 | 9539 | 2474 | 3D | S3A | 1Z | 9108 |
| * 0202313 | 4347 | 0 | 60200 | 2475 | 7C | | 7C | 9108 |
| * 0202321 | 4445 | 815 | 9226 | 2474 | 7C | S3B | 3B | 9108 |
| * 0202321 | 4445 | 0 | 9226 | 2174 | 4D | S3B | 7C | 9108 |
| * 0202354 | 5027 | 144 | 9629 | 2174 | 3W | S3B | 1Z | 9108 |
| * 0202363 | 4750 | 470 | 9646 | 2474 | 7C | S3B | 7L | 9108 |
| * 0202374 | 3838 | 1018 | 9287 | 2474 | 5Q | S3B | 3W | 9108 |
| * 0202384 | 4479 | 1067 | 9539 | 2174 | 3W | S3A | 1Z | 9108 |
| * 0202390 | 5473 | 648 | 9572 | 2174 | 3W | S3B | 3D | 9108 |
| * 0202395 | 4954 | 895 | 65885 | 2374 | 4D | S3A | 7C | 9108 |
| * 0202401 | 4803 | 26 | 9539 | 2474 | 3P | S3B | 7C | 9108 |
| * 0202403 | 4777 | 478 | 9226 | 2174 | 3W | S3B | 3Q | 9108 |
| * 0202406 | 3635 | 830 | 9353 | 2474 | 1Z | S3B | 5C | 9108 |
| * 0202426 | 5476 | 1008 | 9226 | 2474 | 3T | S3B | 7C | 9108 |
| * 0201101 | 5295 | 490 | 9646 | 2474 | 1Z | S3B | 6F | 9109 |
| * 0201118 | 5480 | 386 | 9381 | 2174 | 3W | S3A | 3W | 9109 |
| * 0202016 | 5411 | 504 | 9204 | 2474 | 1Z | S3A | 3R | 9109 |
| * 0202040 | 5012 | 839 | 9263 | 2174 | 4D | S3A | 7C | 9109 |
| * 0202045 | 3008 | 79 | 9539 | 2474 | 5Q | S3A | 3U | 9109 |
| * 0202079 | 6224 | 960 | 9539 | 2474 | 7C | S3B | 7C | 9109 |
| * 0202087 | 4406 | 67 | 9539 | 2474 | 5Q | S3A | 5Q | 9109 |
| * 0202093 | 4071 | 161 | 9381 | 2174 | 3W | S3A | 7C | 9109 |
| * 0202118 | 5171 | 364 | 9629 | 2174 | 3W | S3B | 7C | 9109 |
| * 0202147 | 5144 | 740 | 9298 | 2174 | 4D | S3A | 5C | 9109 |
| * 0202150 | 6417 | 1041 | 9298 | 2474 | 7C | S3A | 7C | 9109 |
| * 0202176 | 4607 | 599 | 9381 | 2174 | 3W | S3A | 2N | 9109 |
| * 0202183 | 5624 | 1430 | 65885 | 2374 | 4D | S3B | 5C | 9109 |
| * 0202183 | 5624 | 1430 | 65885 | 3372 | 1Z | | 5C | 9109 |
| * 0202192 | 5137 | 1900 | 65885 | 2374 | 4D | S3B | 5C | 9109 |
| * 0202206 | 4390 | 498 | 52947 | 2474 | 7C | US3A | 3P | 9109 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202210 | 3592 | 468 | 9381 | 2174 | 3W | S3A | 5G | 9109 |
| * 0202219 | 4854 | 785 | 9345 | 2474 | 3R | S3A | 5G | 9109 |
| * 0202243 | 5235 | 1469 | 9572 | 2174 | 4D | S3B | 7C | 9109 |
| * 0202247 | 3651 | 30 | 9226 | 2174 | 3W | S3B | 6P | 9109 |
| * 0202261 | 5484 | 459 | 9629 | 2474 | 7C | S3B | 2S | 9109 |
| * 0202263 | 5772 | 530 | 9263 | 2474 | 1Z | S3A | 7C | 9109 |
| * 0202276 | 5359 | 881 | 9539 | 2474 | 7C | S3B | 7C | 9109 |
| * 0202283 | 3725 | 7 | 9572 | 2474 | 5W | S3B | 3B | 9109 |
| * 0202284 | 4160 | 399 | 9226 | 2474 | 2N | S3B | 5C | 9109 |
| * 0202319 | 5303 | 333 | 9204 | 2474 | 3B | S3A | 1Z | 9109 |
| * 0202341 | 5612 | 1120 | 9381 | 2174 | 4D | S3A | 7D | 9109 |
| * 0202348 | 4640 | 85 | 9192 | 2174 | 3W | S3A | 7K | 9109 |
| * 0202375 | 5367 | 806 | 9298 | 2474 | 6P | S3A | 1Z | 9109 |
| * 0202388 | 3851 | 365 | 9192 | 2174 | 3W | S3A | 2N | 9109 |
| * 0202434 | 3527 | 311 | 9572 | 2174 | 4D | S3B | 7C | 9109 |
| * 0201022 | 3538 | 462 | 9353 | 2174 | 3W | S3B | 3Q | 9110 |
| * 0201022 | 3549 | 473 | 9381 | 2174 | 3W | S3B | 3Q | 9110 |
| * 0201125 | 5057 | 561 | 9381 | 2174 | 3W | S3B | 7C | 9110 |
| * 0202004 | 5740 | 658 | 9192 | 2174 | 3W | S3A | 7C | 9110 |
| * 0202009 | 5251 | 0 | 9226 | 2174 | 3W | S3B | 1W | 9110 |
| * 0202010 | 4406 | 299 | 9646 | 2474 | 3Q | S3B | 3Q | 9110 |
| * 0202035 | 3215 | 2 | 9739 | 2474 | 3A | S3B | 3U | 9110 |
| * 0202052 | 4462 | 551 | 65885 | 2374 | 4D | S3A | 7C | 9110 |
| * 0202068 | 4593 | 146 | 9539 | 2174 | 3W | S3B | 7C | 9110 |
| * 0202072 | 4386 | 750 | 9263 | 2174 | 4D | S3A | 5Q | 9110 |
| * 0202086 | 2287 | 140 | 9539 | 2174 | 3W | S3B | 3T | 9110 |
| * 0202090 | 3437 | 0 | 9629 | 2474 | 2C | S3B | 2A | 9110 |
| * 0202091 | 4211 | 149 | 9345 | 2174 | 3W | S3A | 6Q | 9110 |
| * 0202098 | 4847 | 601 | 52947 | 2474 | 8B | US3A | 7K | 9110 |
| * 0202108 | 4858 | 292 | 9539 | 2174 | 3W | S3B | 7C | 9110 |
| * 0202111 | 4754 | 525 | 9204 | 2474 | 7C | S3A | 7C | 9110 |
| * 0202113 | 4709 | 544 | 9192 | 2174 | 3W | S3A | 1Z | 9110 |
| * 0202117 | 3939 | 0 | 9226 | 2174 | 3W | S3B | 5Q | 9110 |
| * 0202125 | 6418 | 616 | 9204 | 2474 | 1Z | S3A | 7L | 9110 |
| * 0202136 | 5130 | 397 | 9646 | 2474 | 7C | S3B | 7C | 9110 |
| * 0202147 | 5165 | 761 | 9263 | 2474 | 2F | S3A | 5C | 9110 |
| * 0202148 | 3063 | 1016 | 9263 | 2174 | 4D | S3A | 7C | 9110 |
| * 0202151 | 4906 | 553 | 9572 | 2474 | 7A | S3B | 5D | 9110 |
| * 0202156 | 6541 | 181 | 9572 | 2474 | 4B | S3B | 7D | 9110 |
| * 0202160 | 4880 | 62 | 9539 | 2474 | 5Q | S3B | 3T | 9110 |
| * 0202173 | 3300 | 290 | 9539 | 2474 | 5Q | S3B | 5Q | 9110 |
| * 0202180 | 5657 | 340 | 9345 | 2174 | 3W | S3A | 7C | 9110 |
| * 0202199 | 6439 | 186 | 9646 | 2174 | 3W | S3B | 7C | 9110 |
| * 0202211 | 3881 | 468 | 9739 | 2474 | 5G | S3B | 3U | 9110 |
| * 0202220 | 3029 | 0 | 3366 | 2475 | 3W |  | 3M | 9110 |
| * 0202234 | 4121 | 306 | 9204 | 2474 | 1W | S3A | 3W | 9110 |
| * 0202243 | 5235 | 1469 | 9539 | 2174 | 3W | S3A | 7C | 9110 |
| * 0202248 | 4330 | 855 | 9226 | 2174 | 3W | S3B | 7K | 9110 |
| * 0202280 | 3762 | 355 | 9287 | 2474 | 3A | S3B | 7C | 9110 |
| * 0202281 | 5626 | 687 | 9646 | 2174 | 3W | S3B | 6A | 9110 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202283 | 3725 | 0 | 9539 | 2174 | 3W | S3A | 5W | 9110 |
| * 0202299 | 5795 | 480 | 52947 | 2474 | 7K | US3A | 6F | 9110 |
| * 0202300 | 4363 | 407 | 9646 | 2474 | 3D | S3B | 1Z | 9110 |
| * 0202317 | 4173 | 373 | 9345 | 2474 | 8B | S3A | 7C | 9110 |
| * 0202326 | 5080 | 677 | 9204 | 2474 | 7C | S3A | 3A | 9110 |
| * 0202353 | 5210 | 731 | 9353 | 2174 | 3W | S3B | 7C | 9110 |
| * 0202357 | 2673 | 0 | 9287 | 2174 | 3W | S3A | 7C | 9110 |
| * 0202361 | 4347 | 1052 | 9226 | 2174 | 3W | S3B | 7K | 9110 |
| * 0202369 | 5015 | 751 | 55600 | 2474 | 7C | S3B | 3Q | 9110 |
| * 0202441 | 5387 | 588 | 65885 | 2374 | 4D | S3A | 5Q | 9110 |
| * 0201114 | 4807 | 1100 | 55566 | 2474 | 3M | S3A | 5C | 9111 |
| * 0202028 | 4177 | 998 | 9298 | 2174 | 5Q | S3A | 3Q | 9111 |
| * 0202071 | 3941 | 176 | 9298 | 2174 | 5Q | S3A | 7C | 9111 |
| * 0202076 | 4161 | 327 | 9298 | 2174 | 5Q | S3B | 7C | 9111 |
| * 0202121 | 5854 | 338 | 65885 | 2374 | 4D | S3B | 7C | 9111 |
| * 0202121 | 5854 | 338 | 65885 | 3372 | 3A |  | 7C | 9111 |
| * 0202141 | 4670 | 113 | 9629 | 2174 | 3W | S3B | 6F | 9111 |
| * 0202157 | 3418 | 212 | 9629 | 2474 | 8B | S3B | 7G | 9111 |
| * 0202163 | 3231 | 216 | 9298 | 2174 | 3W | S3A | 7C | 9111 |
| * 0202172 | 5388 | 0 | 9629 | 2475 | 7C |  | 7C | 9111 |
| * 0202174 | 6001 | 4 | 9192 | 2174 | 3W | S3A | 5C | 9111 |
| * 0202205 | 4938 | 5 | 9192 | 2174 | 3W | S3A | 1Z | 9111 |
| * 0202208 | 5107 | 458 | 48556 | 2374 | 4D | S3A | 3Q | 9111 |
| * 0202217 | 5476 | 194 | 9298 | 2474 | 3B | S3A | 6K | 9111 |
| * 0202243 | 5277 | 1511 | 9298 | 2174 | 4D | S3B | 7C | 9111 |
| * 0202262 | 5036 | 0 | 55600 | 2174 | 3W | S3B | 6F | 9111 |
| * 0202354 | 5165 | 282 | 9629 | 2174 | 3W | S3B | 1Z | 9111 |
| * 0202362 | 4323 | 566 | 55600 | 2174 | 3W | S3B | 3R | 9111 |
| * 0202364 | 5395 | 52 | 9298 | 2174 | 5Q | S3A | 7D | 9111 |
| * 0202366 | 4904 | 476 | 9298 | 2174 | 3W | S3A | 3Q | 9111 |
| * 0202385 | 4196 | 142 | 48556 | 2374 | 4D | S3A | 7D | 9111 |
| * 0202390 | 5578 | 753 | 9629 | 2174 | 3W | S3B | 3D | 9111 |
| * 0202409 | 5098 | 691 | 9739 | 2474 | 8B | S3B | 6Q | 9111 |
| * 0202420 | 4903 | 4 | 65885 | 2374 | 4D | S3A | 6F | 9111 |
| * 0202423 | 4393 | 161 | 9192 | 2174 | 3W | S3A | 5C | 9111 |
| * 0202424 | 4417 | 149 | 9345 | 2174 | 4D | S3A | 7D | 9111 |
| * 0202431 | 4134 | 185 | 9192 | 2174 | 3W | S3A | 1R | 9111 |
| * 0202432 | 4573 | 46 | 9539 | 2474 | 1Z | S3A | 5D | 9111 |
| * 0202433 | 3892 | 1157 | 65885 | 2374 | 4D | S3B | 5Q | 9111 |
| * 0202433 | 3892 | 1157 | 65885 | 3372 | 3A |  | 5Q | 9111 |
| * 0202434 | 3612 | 396 | 9539 | 2174 | 3W | S3B | 7C | 9111 |
| * 0202441 | 5387 | 588 | 65885 | 3372 | 5G |  | 5Q | 9111 |
| * 0202020 | 4687 | 429 | 9204 | 2174 | 3W | S3A | 7C | 9112 |
| * 0202028 | 4177 | 998 | 9298 | 2474 | 5Q | S3A | 3Q | 9112 |
| * 0202030 | 4187 | 341 | 9192 | 2174 | 3W | S3A | 1Z | 9112 |
| * 0202031 | 5880 | 346 | 9298 | 2474 | 5Q | S3A | 6F | 9112 |
| * 0202036 | 6786 | 120 | 52947 | 2474 | 2S | US3A | 5Q | 9112 |
| * 0202038 | 4184 | 618 | 9298 | 2174 | 3W | S3A | 1Z | 9112 |
| * 0202061 | 6754 | 1419 | 9192 | 2174 | 3W | S3A | 5G | 9112 |
| * 0202071 | 3942 | 177 | 9298 | 2174 | 5Q | S3A | 7C | 9112 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202081 | 5274 | 916 | 9298 | 2174 | 3W | S3A | 4P | 9112 |
| * 0202156 | 6541 | 0 | 60200 | 2475 | 3B | | 5D | 9112 |
| * 0202158 | 5234 | 0 | 3369 | 2475 | 3W | | 6P | 9112 |
| * 0202186 | 4459 | 98 | 65885 | 2374 | 4D | US3A | 5Q | 9112 |
| * 0202186 | 4459 | 98 | 65885 | 3372 | 3A | | 5Q | 9112 |
| * 0202209 | 4659 | 138 | 9204 | 2174 | 3W | S3A | 3R | 9112 |
| * 0202215 | 4998 | 1538 | 9539 | 2474 | 7C | S3B | 3T | 9112 |
| * 0202241 | 4777 | 510 | 65885 | 2374 | 4D | S3A | 7C | 9112 |
| * 0202273 | 5078 | 1291 | 65885 | 2374 | 4D | S3A | 3W | 9112 |
| * 0202323 | 4762 | 124 | 65885 | 2374 | 4D | US3A | 8P | 9112 |
| * 0202329 | 5971 | 881 | 9739 | 2474 | 7C | S3B | 7D | 9112 |
| * 0202340 | 4619 | 4 | 9739 | 2474 | 1W | S3B | 4B | 9112 |
| * 0202364 | 5398 | 55 | 9298 | 2474 | 5Q | S3B | 7D | 9112 |
| * 0201021 | 3893 | 534 | 9287 | 2474 | 7C | S3B | 1Z | 9201 |
| * 0201104 | 5430 | 103 | 9298 | 2174 | 3W | S3A | 6J | 9201 |
| * 0201108 | 5129 | 109 | 9204 | 2174 | 3W | S3A | 7C | 9201 |
| * 0202004 | 5774 | 692 | 9381 | 2474 | 3R | S3B | 7C | 9201 |
| * 0202005 | 5317 | 105 | 9263 | 2474 | 1W | S3A | 3Q | 9201 |
| * 0202011 | 4048 | 358 | 9629 | 2474 | 3Q | S3B | 7C | 9201 |
| * 0202025 | 5380 | 151 | 9298 | 2474 | 1W | S3A | 3R | 9201 |
| * 0202043 | 5083 | 4 | 65885 | 2374 | 4D | S3A | 7C | 9201 |
| * 0202056 | 3600 | 1103 | 9192 | 2174 | 3W | S3A | 7C | 9201 |
| * 0202064 | 5630 | 508 | 9298 | 2174 | 3W | S3A | 7A | 9201 |
| * 0202066 | 4376 | 1321 | 55600 | 2174 | 3W | S3B | 5G | 9201 |
| * 0202070 | 4390 | 3 | 9539 | 2474 | 5Q | S3B | 7C | 9201 |
| * 0202071 | 3943 | 178 | 9298 | 2474 | 1W | S3A | 7C | 9201 |
| * 0202084 | 6179 | 1198 | 9192 | 2174 | 3W | S3A | 5Q | 9201 |
| * 0202093 | 4202 | 292 | 9381 | 2174 | 3W | S3A | 7C | 9201 |
| * 0202112 | 4926 | 1198 | 9192 | 2174 | 3W | S3A | 3T | 9201 |
| * 0202150 | 6417 | 0 | 246 | 2475 | 1W | | 7C | 9201 |
| * 0202153 | 4991 | 326 | 9298 | 2174 | 3W | S3A | 7C | 9201 |
| * 0202167 | 4022 | 937 | 9298 | 2474 | 1W | S3A | 5Q | 9201 |
| * 0202174 | 6077 | 80 | 9192 | 2174 | 3W | S3A | 5C | 9201 |
| * 0202174 | 6077 | 80 | 9192 | 2475 | 6A | | 5C | 9201 |
| * 0202190 | 5460 | 337 | 9298 | 2174 | 3W | S3A | 7G | 9201 |
| * 0202197 | 5577 | 1116 | 9629 | 2474 | 3Q | S3B | 7K | 9201 |
| * 0202212 | 5383 | 320 | 9353 | 2474 | 2N | S3B | 7C | 9201 |
| * 0202214 | 5431 | 459 | 9204 | 2474 | 3T | S3A | 7D | 9201 |
| * 0202241 | 4777 | 510 | 65885 | 3372 | 3A | | 7C | 9201 |
| * 0202253 | 5696 | 801 | 9345 | 2174 | 3W | S3A | 3M | 9201 |
| * 0202254 | 5900 | 127 | 9298 | 2174 | 3W | S3A | 7C | 9201 |
| * 0202259 | 3994 | 896 | 9298 | 2474 | 3Q | S3A | 1Z | 9201 |
| * 0202262 | 5036 | 0 | 55600 | 2174 | 3W | S3B | 6F | 9201 |
| * 0202262 | 5036 | 0 | 55600 | 2474 | 3P | S3B | 6F | 9201 |
| * 0202273 | 5078 | 1291 | 65885 | 3372 | 3A | | 3W | 9201 |
| * 0202290 | 4585 | 371 | 9572 | 2474 | 3Q | S3B | 3R | 9201 |
| * 0202291 | 4232 | 83 | 9345 | 2174 | 3W | S3A | 5C | 9201 |
| * 0202294 | 4063 | 200 | 9298 | 2174 | 5Q | S3A | 5Q | 9201 |
| * 0202297 | 5190 | 492 | 9298 | 2474 | 1W | S3A | 7C | 9201 |
| * 0202324 | 4750 | 764 | 9298 | 2174 | 3W | S3B | 3Q | 9201 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202327 | 6318 | 222 | 9263 | 2174 | 3W | S3A | 7D | 9201 |
| * 0202333 | 4442 | 1121 | 9263 | 2474 | 5Q | S3A | 7C | 9201 |
| * 0202356 | 4973 | 315 | 65885 | 2374 | 4D | S3A | 6Q | 9201 |
| * 0202366 | 4968 | 540 | 9298 | 2474 | 5Q | S3A | 3Q | 9201 |
| * 0202368 | 4447 | 757 | 9298 | 2474 | 1W | S3A | 5C | 9201 |
| * 0202384 | 4630 | 1218 | 9539 | 2474 | 2N | S3B | 1Z | 9201 |
| * 0202390 | 5679 | 854 | 55600 | 2474 | 7C | S3B | 3D | 9201 |
| * 0202398 | 4898 | 178 | 9298 | 2174 | 5Q | S3A | 3R | 9201 |
| * 0202403 | 5027 | 728 | 9226 | 2474 | 3R | S3B | 3Q | 9201 |
| * 0202424 | 4511 | 243 | 9298 | 2474 | 1W | S3A | 7D | 9201 |
| * 0202444 | 5171 | 511 | 9572 | 2474 | 5W | S3B | 1Z | 9201 |
| * 0201116 | 5034 | 0 | 9298 | 2174 | 3W | S3A | 1Z | 9202 |
| * 0201127 | 4600 | 75 | 55566 | 2474 | 6F | S3A | 4M | 9202 |
| * 0202002 | 4606 | 646 | 9192 | 2174 | 3W | S3A | 6P | 9202 |
| * 0202024 | 4908 | 130 | 52947 | 2474 | 3P | US3A | 3D | 9202 |
| * 0202029 | 5282 | 748 | 9298 | 2174 | 3W | S3A | 7C | 9202 |
| * 0202035 | 3297 | 82 | 9739 | 2474 | 1W | S3B | 3A | 9202 |
| * 0202048 | 5037 | 424 | 65885 | 2374 | 4D | S3A | 1Z | 9202 |
| * 0202055 | 5578 | 191 | 65885 | 2374 | 4D | S3A | 3T | 9202 |
| * 0202056 | 3600 | 1103 | 9192 | 2174 | 3W | S3A | 7C | 9202 |
| * 0202056 | 3600 | 1103 | 9192 | 2174 | 3W | S3A | 7C | 9202 |
| * 0202089 | 4971 | 529 | 9298 | 2474 | 3Q | S3A | 7J | 9202 |
| * 0202112 | 4963 | 1235 | 9192 | 2174 | 3W | S3A | 3T | 9202 |
| * 0202143 | 5175 | 1026 | 9739 | 2474 | 3P | S3B | 7C | 9202 |
| * 0202163 | 3258 | 243 | 9298 | 2174 | 3W | S3A | 7C | 9202 |
| * 0202192 | 5169 | 1932 | 9287 | 2474 | 2N | S3B | 5C | 9202 |
| * 0202222 | 5931 | 605 | 9298 | 2174 | 3W | S3A | 2F | 9202 |
| * 0202229 | 4097 | 226 | 65885 | 2374 | 4D | S3A | 5Q | 9202 |
| * 0202254 | 5922 | 149 | 9298 | 2474 | 5Q | S3A | 7C | 9202 |
| * 0202309 | 4760 | 987 | 55600 | 2474 | 7C | S3B | 5B | 9202 |
| * 0202311 | 4117 | 365 | 9298 | 2174 | 3W | S3A | 5C | 9202 |
| * 0202311 | 4117 | 365 | 9298 | 2174 | 3W | S3A | 5C | 9202 |
| * 0202341 | 5777 | 1285 | 9263 | 2174 | 4D | S3A | 7D | 9202 |
| * 0202356 | 4973 | 315 | 65885 | 3372 | 1Z |  | 6Q | 9202 |
| * 0202377 | 4469 | 291 | 9572 | 2474 | 2S | S3B | 1G | 9202 |
| * 0202388 | 3855 | 369 | 65885 | 2374 | 4D | S3A | 2N | 9202 |
| * 0202398 | 4963 | 243 | 9298 | 2174 | 3W | S3A | 3R | 9202 |
| * 0202409 | 5098 | 0 | 9739 | 2174 | 3W | S3B | 8B | 9202 |
| * 0202419 | 2413 | 492 | 52947 | 2474 | 6N | US3A | 1W | 9202 |
| * 0202430 | 5230 | 782 | 9739 | 2474 | 7C | S3B | 4D | 9202 |
| * 0202440 | 5149 | 561 | 9739 | 2474 | 7A | S3B | 4P | 9202 |
| * 0201119 | 5569 | 322 | 9287 | 2474 | 6Q | S3B | 7C | 9203 |
| * 0201120 | 5088 | 47 | 55566 | 2174 | 3W | S3A | 6Q | 9203 |
| * 0201123 | 4958 | 415 | 9629 | 2474 | 7C | S3B | 7C | 9203 |
| * 0201124 | 2530 | 170 | 9298 | 2474 | 1Z | S3B | 1R | 9203 |
| * 0202006 | 5438 | 1473 | 55566 | 2474 | 7D | S3A | 5C | 9203 |
| * 0202018 | 4356 | 221 | 65885 | 2374 | 4D | S3A | 1Z | 9203 |
| * 0202033 | 4448 | 141 | 55600 | 2174 | 3W | S3B | 3U | 9203 |
| * 0202048 | 5037 | 424 | 65885 | 3372 | 1W |  | 1Z | 9203 |
| * 0202056 | 3600 | 1103 | 9192 | 2474 | 3R | S3A | 7C | 9203 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202065 | 3090 | 436 | 9539 | 2474 | 8F | S3B | 7C | 9203 |
| * 0202066 | 4399 | 1344 | 55600 | 2174 | 3W | S3B | 5G | 9203 |
| * 0202067 | 2761 | 1096 | 9287 | 2474 | 3P | S3B | 5C | 9203 |
| * 0202103 | 2543 | 1559 | 9192 | 2174 | 3W | S3A | | 9203 |
| * 0202103 | 2550 | 1566 | 9287 | 2474 | 7C | S3B | | 9203 |
| * 0202116 | 5030 | 517 | 9629 | 2474 | 7C | S3B | 2N | 9203 |
| * 0202120 | 3405 | 411 | 9572 | 2474 | 3T | S3B | 3B | 9203 |
| * 0202173 | 3365 | 65 | 9539 | 2474 | 3T | S3B | 5Q | 9203 |
| * 0202204 | 5397 | 137 | 9192 | 2174 | 3W | S3A | 5B | 9203 |
| * 0202228 | 5768 | 817 | 55566 | 2474 | 6F | S3A | 3W | 9203 |
| * 0202229 | 4097 | 226 | 65885 | 3372 | 1W | | 5Q | 9203 |
| * 0202304 | 3551 | 247 | 9226 | 2474 | 7C | S3B | 7C | 9203 |
| * 0202308 | 4450 | 181 | 9204 | 2174 | 4D | S3A | 2Q | 9203 |
| * 0202314 | 3112 | 636 | 65885 | 2374 | 4D | S3A | 7L | 9203 |
| * 0202317 | 4238 | 65 | 9298 | 2474 | 1W | S3A | 3R | 9203 |
| * 0202326 | 5083 | 3 | 55566 | 2474 | 3T | S3A | 7D | 9203 |
| * 0202331 | 3955 | 792 | 9539 | 2474 | 7C | S3B | 3A | 9203 |
| * 0202353 | 5541 | 1062 | 9353 | 2474 | 3Q | S3B | 7C | 9203 |
| * 0202365 | 6362 | 340 | 9739 | 2474 | 6N | S3B | 6J | 9203 |
| * 0202401 | 4855 | 52 | 9539 | 2474 | 3R | S3B | 3B | 9203 |
| * 0202412 | 4753 | 137 | 9192 | 2174 | 3W | S3A | 3R | 9203 |
| * 0202413 | 4939 | 431 | 9539 | 2174 | 3W | S3B | 7C | 9203 |
| * 0202438 | 5315 | 1316 | 9539 | 2174 | 3W | S3B | 5C | 9203 |
| * 0201120 | 5131 | 90 | 55566 | 2174 | 3W | S3A | 6Q | 9204 |
| * 0202007 | 2179 | 401 | 9646 | 2174 | 3W | S3B | 7C | 9204 |
| * 0202012 | 5385 | 853 | 9646 | 2474 | 7C | S3B | 6E | 9204 |
| * 0202023 | 5504 | 747 | 52947 | 2474 | 5Q | US3A | 3P | 9204 |
| * 0202026 | 6021 | 483 | 65885 | 2374 | 4D | S3B | 6P | 9204 |
| * 0202034 | 3771 | 842 | 9539 | 2174 | 3W | S3B | 5C | 9204 |
| * 0202054 | 3814 | 465 | 52947 | 2474 | 3M | US3A | 6F | 9204 |
| * 0202074 | 4217 | 659 | 65885 | 2374 | 4D | S3B | 2N | 9204 |
| * 0202074 | 4217 | 659 | 65885 | 3372 | 6Q | | 2N | 9204 |
| * 0202084 | 6470 | 1489 | 9192 | 2474 | 7C | S3A | 5Q | 9204 |
| * 0202086 | 2344 | 197 | 65885 | 2374 | 4D | S3A | 3T | 9204 |
| * 0202096 | 2225 | 189 | 9539 | 2174 | 3W | S3B | 3B | 9204 |
| * 0202108 | 4915 | 349 | 65885 | 2374 | 4D | S3A | 7C | 9204 |
| * 0202117 | 4314 | 375 | 9226 | 2174 | 4D | S3B | 5Q | 9204 |
| * 0202164 | 5998 | 981 | 9646 | 2174 | 3W | S3B | 3A | 9204 |
| * 0202196 | 4275 | 1105 | 9298 | 2474 | 5W | S3B | 3D | 9204 |
| * 0202268 | 5627 | 1199 | 9739 | 2474 | 1Z | S3B | 3R | 9204 |
| * 0202281 | 5954 | 1015 | 9646 | 2474 | 1Z | S3B | 6A | 9204 |
| * 0202343 | 5630 | 893 | 9345 | 2474 | 3T | S3A | 3R | 9204 |
| * 0202386 | 4711 | 172 | 9345 | 2174 | 3W | S3A | 4B | 9204 |
| * 0202394 | 3561 | 1063 | 9226 | 2474 | 2N | S3B | 7C | 9204 |
| * 0202404 | 5107 | 43 | 9629 | 2474 | 2N | S3B | 5B | 9204 |
| * 0202406 | 3650 | 15 | 55566 | 2474 | 7K | S3A | 1Z | 9204 |
| * 0202416 | 4010 | 1177 | 9204 | 2174 | 3W | S3A | 3Q | 9204 |
| * 0201116 | 5155 | 121 | 9298 | 2174 | 3W | S3A | 1Z | 9205 |
| * 0202027 | 5258 | 846 | 9539 | 2174 | 3W | S3B | 3T | 9205 |
| * 0202051 | 3989 | 384 | 9345 | 2474 | 6N | S3A | 3R | 9205 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202069 | 5422 | 138 | 52947 | 2474 | 7K | US3A | 7D | 9205 |
| * 0202145 | 3543 | 407 | 48556 | 3372 | 4D | | 5C | 9205 |
| * 0202179 | 4100 | 0 | 3366 | 2475 | 3W | | 7D | 9205 |
| * 0202181 | 6927 | 930 | 9539 | 2474 | 8B | S3B | 5Q | 9205 |
| * 0202182 | 6570 | 1336 | 9353 | 2474 | 3M | S3B | 7C | 9205 |
| * 0202204 | 5482 | 222 | 9192 | 2174 | 3W | S3A | 5B | 9205 |
| * 0202211 | 4099 | 218 | 52947 | 2474 | 1Z | US3A | 7D | 9205 |
| * 0202224 | 5548 | 384 | 9345 | 2174 | 3W | S3A | 1Z | 9205 |
| * 0202234 | 4206 | 85 | 52947 | 2474 | 5Q | US3A | 3T | 9205 |
| * 0202235 | 5050 | 1 | 52947 | 2474 | 5Q | US3A | 3D | 9205 |
| * 0202248 | 4340 | 865 | 65885 | 2374 | 4D | S3B | 7K | 9205 |
| * 0202248 | 4340 | 865 | 65885 | 3372 | 1Z | | 7K | 9205 |
| * 0202272 | 4721 | 826 | 9263 | 2174 | 3W | S3B | 6F | 9205 |
| * 0202296 | 5765 | 1275 | 9629 | 2474 | 8F | S3B | 4P | 9205 |
| * 0202310 | 4649 | 1605 | 48556 | 3372 | 4D | | 1W | 9205 |
| * 0202321 | 4974 | 529 | 9539 | 2474 | 7K | S3B | 7C | 9205 |
| * 0202342 | 3497 | 670 | 52947 | 2474 | 5Q | US3A | 7K | 9205 |
| * 0202354 | 5488 | 605 | 9629 | 2474 | 8F | S3B | 1Z | 9205 |
| * 0202361 | 4356 | 1061 | 65885 | 2374 | 4D | S3B | 7K | 9205 |
| * 0202376 | 5435 | 188 | 9226 | 2474 | 8C | S3B | 7D | 9205 |
| * 0202405 | 3549 | 110 | 9263 | 2174 | 3W | S3A | 3B | 9205 |
| * 0201108 | 5318 | 298 | 9204 | 2174 | 4D | S3A | 7C | 9206 |
| * 0202007 | 2311 | 533 | 9226 | 2474 | 3T | S3B | 7C | 9206 |
| * 0202026 | 6021 | 483 | 65885 | 2374 | 4D | S3B | 6P | 9206 |
| * 0202047 | 3302 | 1405 | 9204 | 2474 | 7D | S3A | 5W | 9206 |
| * 0202052 | 4466 | 555 | 65885 | 3372 | 3A | | 7C | 9206 |
| * 0202084 | 6540 | 70 | 9192 | 2474 | 1B | S3A | 7D | 9206 |
| * 0202085 | 5255 | 397 | 9204 | 2174 | 3W | S3A | 3T | 9206 |
| * 0202086 | 2344 | 197 | 65885 | 3372 | 4D | | 3T | 9206 |
| * 0202093 | 4482 | 572 | 9381 | 2174 | 3W | S3B | 7C | 9206 |
| * 0202108 | 4915 | 349 | 65885 | 3372 | 4D | | 7C | 9206 |
| * 0202113 | 5051 | 886 | 9381 | 2474 | 7K | S3B | 1Z | 9206 |
| * 0202138 | 4726 | 1389 | 9287 | 2474 | 5Q | S3B | 7C | 9206 |
| * 0202153 | 5342 | 677 | 9298 | 2174 | 3W | S3A | 7C | 9206 |
| * 0202155 | 4777 | 705 | 65885 | 2374 | 4D | S3B | 1Z | 9206 |
| * 0202169 | 5167 | 542 | 9381 | 2474 | 6A | S3B | 1Z | 9206 |
| * 0202189 | 4678 | 50 | 9298 | 2174 | 3W | S3A | 7C | 9206 |
| * 0202205 | 5163 | 230 | 9192 | 2474 | 8F | S3A | 1Z | 9206 |
| * 0202210 | 3727 | 603 | 65885 | 2374 | 4D | S3A | 5G | 9206 |
| * 0202219 | 4857 | 3 | 65885 | 2374 | 4D | S3A | 3R | 9206 |
| * 0202256 | 5163 | 121 | 9298 | 2174 | 3W | S3A | 7D | 9206 |
| * 0202274 | 3520 | 1363 | 9298 | 2474 | 7C | S3A | 7L | 9206 |
| * 0202298 | 4227 | 521 | 63282 | 2474 | 3M | S3A | 2N | 9206 |
| * 0202301 | 3042 | 1007 | 9739 | 2474 | 7K | S3B | 7D | 9206 |
| * 0202308 | 4541 | 272 | 9298 | 2474 | 1Z | S3B | 2Q | 9206 |
| * 0202346 | 4799 | 484 | 55567 | 2474 | 3Q | S3A | 5W | 9206 |
| * 0202347 | 4196 | 586 | 9381 | 2474 | 6Q | S3B | 2N | 9206 |
| * 0202355 | 5506 | 1015 | 9263 | 2174 | 3W | S3A | 3Q | 9206 |
| * 0202357 | 2951 | 278 | 9287 | 2474 | 4B | S3B | 7C | 9206 |
| * 0202359 | 5094 | 346 | 9263 | 2174 | 3W | S3A | 3T | 9206 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202370 | 5656 | 288 | 9204 | 2174 | 4D | S3A | 3T | 9206 |
| * 0202370 | 5656 | 288 | 9298 | 2174 | 4D | S3A | 3T | 9206 |
| * 0202374 | 3870 | 32 | 9226 | 2474 | 5Q | S3B | 5Q | 9206 |
| * 0202426 | 5523 | 47 | 65885 | 2374 | 4D | S3B | 3T | 9206 |
| * 0201113 | 5914 | 579 | 9287 | 2474 | 6F | S3B | 3B | 9207 |
| * 0202026 | 6021 | 483 | 65885 | 3372 | 4D |  | 6P | 9207 |
| * 0202029 | 5509 | 975 | 9298 | 2474 | 2S | S3A | 7C | 9207 |
| * 0202042 | 5606 | 596 | 9345 | 2474 | 3R | S3A | 7C | 9207 |
| * 0202078 | 2976 | 99 | 9298 | 2474 | 1Z | S3A | 4D | 9207 |
| * 0202088 | 4828 | 912 | 9539 | 2474 | 3R | S3B | 1G | 9207 |
| * 0202130 | 6138 | 899 | 9381 | 2474 | 7C | S3B | 1Z | 9207 |
| * 0202141 | 4946 | 389 | 9629 | 2474 | 3A | S3B | 6F | 9207 |
| * 0202155 | 4777 | 705 | 65885 | 3372 | 4D |  | 1Z | 9207 |
| * 0202156 | 6631 | 90 | 9539 | 2474 | 5W | S3B | 3B | 9207 |
| * 0202192 | 5218 | 49 | 9629 | 2174 | 3W | S3B | 1W | 9207 |
| * 0202195 | 4615 | 727 | 9298 | 2474 | 7K | S3B | 7C | 9207 |
| * 0202239 | 4595 | 228 | 9739 | 2474 | 9J | S3B | 5W | 9207 |
| * 0202254 | 5992 | 70 | 9298 | 2174 | 3W | S3A | 5Q | 9207 |
| * 0202269 | 4476 | 564 | 9298 | 2174 | 3W | S3B | 5Q | 9207 |
| * 0202278 | 5710 | 225 | 65885 | 2374 | 4D | S3B | 1W | 9207 |
| * 0202285 | 5388 | 1236 | 9192 | 2174 | 3W | S3A | 1Z | 9207 |
| * 0202287 | 4405 | 515 | 9298 | 2174 | 3W | S3A | 7C | 9207 |
| * 0202294 | 4376 | 513 | 9298 | 2174 | 3W | S3A | 5Q | 9207 |
| * 0202327 | 6538 | 442 | 9345 | 2174 | 3W | S3A | 7D | 9207 |
| * 0202334 | 5431 | 1444 | 0421F | 2474 | 7C | ES3A | 5C | 9207 |
| * 0202336 | 5380 | 225 | 65885 | 2374 | 4D | S3B | 3Q | 9207 |
| * 0202351 | 5172 | 1097 | 9381 | 2474 | 8C | S3B | 1G | 9207 |
| * 0202361 | 4365 | 1070 | 9353 | 2474 | 7C | S3B | 7K | 9207 |
| * 0202393 | 5032 | 232 | 9298 | 2474 | 6J | S3A | 1Z | 9207 |
| * 0202400 | 4463 | 305 | 0421F | 2474 | 7C | ES3A | 6P | 9207 |
| * 0202402 | 5474 | 447 | 9572 | 2474 | 8F | S3B | 3U | 9207 |
| * 0202438 | 5418 | 1419 | 9539 | 2474 | 5W | S3B | 5C | 9207 |
| * 0201116 | 5245 | 211 | 9298 | 2174 | 3W | S3A | 1Z | 9208 |
| * 0201117 | 6400 | 1579 | 9287 | 2474 | 7C | S3B | 8F | 9208 |
| * 0202001 | 5199 | 1470 | 9226 | 2474 | 3T | S3B | 6F | 9208 |
| * 0202009 | 5908 | 657 | 9226 | 2474 | 7C | S3B | 1W | 9208 |
| * 0202018 | 4359 | 224 | 65885 | 2374 | 3W | S3A | 1Z | 9208 |
| * 0202022 | 5025 | 638 | 9572 | 2174 | 3W | S3B | 3T | 9208 |
| * 0202036 | 7037 | 251 | 9192 | 2474 | 3T | S3A | 2S | 9208 |
| * 0202045 | 3310 | 302 | 9539 | 2474 | 3R | S3B | 7D | 9208 |
| * 0202064 | 5829 | 707 | 9298 | 2174 | 3W | S3A | 7A | 9208 |
| * 0202132 | 5499 | 1479 | 9572 | 2174 | 3W | S3B | 2N | 9208 |
| * 0202174 | 6097 | 20 | 9298 | 2174 | 3W | S3A | 3T | 9208 |
| * 0202197 | 5766 | 189 | 65885 | 2374 | 4D | S3B | 7D | 9208 |
| * 0202197 | 5766 | 189 | 65885 | 3372 | 3R |  | 7D | 9208 |
| * 0202220 | 3141 | 112 | 9353 | 2174 | 3W | S3B | 7C | 9208 |
| * 0202238 | 5789 | 1087 | 65885 | 2374 | 4D | S3B | 6P | 9208 |
| * 0202256 | 5258 | 216 | 9298 | 2474 | 6J | S3A | 7D | 9208 |
| * 0202265 | 4478 | 623 | 9539 | 2174 | 3W | S3B | 7K | 9208 |
| * 0202280 | 3882 | 120 | 9298 | 2174 | 3W | S3A | 3A | 9208 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202285 | 5401 | 1249 | 9345 | 2474 | 3D | S3A | 1Z | 9208 |
| * 0202307 | 5843 | 1157 | 9353 | 2474 | 3Q | S3B | 7C | 9208 |
| * 0202317 | 4318 | 80 | 9739 | 2474 | 5C | S3B | 1W | 9208 |
| * 0202336 | 5380 | 225 | 65885 | 3372 | 3A | | 3Q | 9208 |
| * 0202342 | 3497 | 0 | 246 | 2475 | 2A | | 5Q | 9208 |
| * 0202362 | 4576 | 819 | 55600 | 2474 | 3Q | S3B | 3R | 9208 |
| * 0202363 | 5016 | 266 | 9287 | 2174 | 3W | S3B | 7C | 9208 |
| * 0202417 | 6405 | 1599 | 9539 | 2474 | 7C | S3B | 3A | 9208 |
| * 0202426 | 5523 | 47 | 65885 | 2374 | 3A | S3A | 3T | 9208 |
| * 0201110 | 5652 | 221 | 55566 | 2474 | 3T | S3A | 6Q | 9209 |
| * 0201111 | 5895 | 356 | 9287 | 2474 | 1B | S3B | 7A | 9209 |
| * 0201127 | 4825 | 225 | 9381 | 2474 | 4R | S3B | 6F | 9209 |
| * 0202002 | 4833 | 873 | 9345 | 2174 | 3W | S3A | 6P | 9209 |
| * 0202064 | 5829 | 707 | 9298 | 2474 | 7C | S3A | 7A | 9209 |
| * 0202112 | 5190 | 1462 | 9345 | 2174 | 3W | S3A | 3T | 9209 |
| * 0202126 | 6081 | 444 | 9204 | 2174 | 3W | S3A | 5Q | 9209 |
| * 0202127 | 6790 | 960 | 9381 | 2474 | 7K | S3B | 1Z | 9209 |
| * 0202150 | 6517 | 0 | 68539 | 2475 | 3W | | 3T | 9209 |
| * 0202158 | 5489 | 255 | 9263 | 2174 | 3W | S3B | 3B | 9209 |
| * 0202169 | 5198 | 31 | 9381 | 2174 | 3W | S3B | 6A | 9209 |
| * 0202171 | 4974 | 314 | 9298 | 2474 | 1Z | S3A | 7K | 9209 |
| * 0202203 | 4327 | 832 | 9381 | 2474 | 7C | S3B | 5Q | 9209 |
| * 0202223 | 7040 | 414 | 65885 | 2374 | 3W | S3A | 3R | 9209 |
| * 0202228 | 5868 | 100 | 9298 | 2474 | 7A | S3B | 6F | 9209 |
| * 0202231 | 5366 | 515 | 9539 | 2174 | 3W | S3B | 3R | 9209 |
| * 0202252 | 4323 | 1436 | 9539 | 2174 | 3W | S3B | 7K | 9209 |
| * 0202263 | 6144 | 372 | 9204 | 2174 | 3W | S3A | 1Z | 9209 |
| * 0202265 | 4483 | 628 | 9539 | 2174 | 3W | S3B | 7K | 9209 |
| * 0202305 | 5087 | 738 | 9192 | 2474 | 5Q | S3A | 5C | 9209 |
| * 0202306 | 4227 | 306 | 9539 | 2174 | 3W | S3B | 7C | 9209 |
| * 0202321 | 5074 | 99 | 9539 | 2474 | 1Z | S3B | 3T | 9209 |
| * 0202327 | 6609 | 513 | 9192 | 2474 | 4R | S3A | 7D | 9209 |
| * 0202334 | 5431 | 0 | 9539 | 2174 | 3W | S3B | 7D | 9209 |
| * 0202355 | 5522 | 1031 | 9345 | 2474 | 7K | S3A | 3Q | 9209 |
| * 0202363 | 5024 | 274 | 9539 | 2474 | 5Q | S3B | 7C | 9209 |
| * 0202370 | 5884 | 516 | 9381 | 2474 | 7C | S3B | 3T | 9209 |
| * 0202373 | 4827 | 869 | 9353 | 2474 | 7C | S3B | 1G | 9209 |
| * 0202398 | 5132 | 412 | 9298 | 2174 | 3W | S3A | 3R | 9209 |
| * 0202420 | 5204 | 305 | 9204 | 2174 | 3W | S3A | 6F | 9209 |
| * 0202428 | 3635 | 516 | 65885 | 2374 | 4D | S3A | 3Q | 9209 |
| * 0202440 | 5149 | 0 | 61577 | 2475 | 3W | | 5C | 9209 |
| * 0202442 | 5080 | 1279 | 9381 | 2474 | 1G | S3B | 6Q | 9209 |
| * 0201106 | 6116 | 253 | 9381 | 2174 | 4D | S3B | 3T | 9210 |
| * 0201112 | 5804 | 615 | 9629 | 2174 | 3W | S3B | 3M | 9210 |
| * 0201127 | 4826 | 1 | 9381 | 2174 | 4D | S3B | 4R | 9210 |
| * 0202043 | 5110 | 31 | 9298 | 2474 | 4B | S3A | 7C | 9210 |
| * 0202051 | 4118 | 129 | 55567 | 2474 | 5Q | S3A | 6N | 9210 |
| * 0202083 | 4269 | 721 | 9345 | 2174 | 4D | S3A | 2C | 9210 |
| * 0202117 | 4488 | 549 | 9539 | 2474 | 7C | S3B | 5Q | 9210 |
| * 0202142 | 6080 | 354 | 65885 | 2374 | 4D | S3B | 2N | 9210 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202142 | 6080 | 354 | 65885 | 3372 | 2A | | 2N | 9210 |
| * 0202154 | 5605 | 858 | 65885 | 2374 | 3W | S3B | 7C | 9210 |
| * 0202154 | 5606 | 859 | 65885 | 3372 | 5C | | 7C | 9210 |
| * 0202164 | 6124 | 1107 | 9539 | 2474 | 1Z | S3B | 3A | 9210 |
| * 0202171 | 4994 | 20 | 9381 | 2474 | 8F | S3B | 1Z | 9210 |
| * 0202179 | 4100 | 0 | 9629 | 2174 | 3W | S3B | 3W | 9210 |
| * 0202218 | 4107 | 1278 | 9381 | 2174 | 4D | S3B | 5C | 9210 |
| * 0202223 | 7040 | 414 | 65885 | 3372 | 3A | | 3R | 9210 |
| * 0202244 | 4705 | 214 | 9204 | 2174 | 3W | S3A | 3D | 9210 |
| * 0202263 | 6230 | 458 | 9381 | 2174 | 4D | S3B | 1Z | 9210 |
| * 0202265 | 4522 | 667 | 9539 | 2474 | 5Q | S3B | 7K | 9210 |
| * 0202272 | 4826 | 931 | 9204 | 2474 | 5G | S3A | 6F | 9210 |
| * 0202280 | 3968 | 206 | 9298 | 2474 | 6F | S3A | 3A | 9210 |
| * 0202313 | 5103 | 756 | 9353 | 2474 | 7C | S3B | 7C | 9210 |
| * 0202319 | 5638 | 335 | 9739 | 2474 | 5Q | S3B | 5Q | 9210 |
| * 0202358 | 5207 | 310 | 65885 | 2374 | 3W | S3B | 7C | 9210 |
| * 0202378 | 5079 | 941 | 9287 | 2474 | 3Q | S3B | 3Q | 9210 |
| * 0202405 | 3679 | 240 | 9263 | 2474 | 2N | S3B | 3B | 9210 |
| * 0202428 | 3635 | 516 | 65885 | 3372 | 6Q | | 3Q | 9210 |
| * 0201128 | 2831 | 898 | 65885 | 2374 | 4D | S3B | 3Q | 9210 |
| * 0201112 | 5804 | 615 | 9539 | 2474 | 3Q | S3B | 3M | 9211 |
| * 0202042 | 5606 | 596 | 9345 | 2174 | 4D | S3A | 7C | 9211 |
| * 0202201 | 5568 | 925 | 9381 | 2474 | 5Q | S3B | 5Q | 9211 |
| * 0202207 | 6437 | 1118 | 9263 | 2174 | 4D | S3B | 1Z | 9211 |
| * 0202269 | 4479 | 567 | 65885 | 2374 | 3W | S3A | 5Q | 9211 |
| * 0202297 | 5190 | 0 | 55566 | 2475 | 4L | | 2N | 9211 |
| * 0202379 | 4109 | 305 | 55566 | 2474 | 7D | S3A | 7C | 9211 |
| * 0202384 | 4902 | 272 | 9629 | 2474 | 7K | S3B | 1W | 9211 |
| * 0202410 | 5636 | 1173 | 9572 | 2474 | 7C | S3B | 3A | 9211 |
| * 0202426 | 5523 | 47 | 65885 | 3372 | 3A | | 3T | 9211 |
| * 0202009 | 5908 | 0 | 60200 | 2475 | 3B | | 7C | 9212 |
| * 0202014 | 3663 | 1353 | 55566 | 2474 | 6N | ES3A | 7E | 9212 |
| * 0202033 | 4600 | 293 | 65885 | 2374 | 3W | S3B | 3U | 9212 |
| * 0202042 | 5606 | 596 | 9263 | 2474 | 7K | S3B | 7C | 9212 |
| * 0202122 | 5234 | 284 | 9629 | 2474 | 8F | S3B | 5Q | 9212 |
| * 0202137 | 5359 | 3 | 9539 | 2474 | 3P | S3B | 3B | 9212 |
| * 0202213 | 5838 | 317 | 9539 | 2174 | 3W | S3B | 3B | 9212 |
| * 0202232 | 6418 | 1007 | 9192 | 2474 | 5Q | S3A | 3R | 9212 |
| * 0202276 | 5885 | 526 | 9629 | 2474 | 7C | S3B | 7C | 9212 |
| * 0202290 | 4782 | 197 | 9539 | 2174 | 3W | S3B | 3Q | 9212 |
| * 0202306 | 4345 | 424 | 9539 | 2174 | 3W | S3B | 7C | 9212 |
| * 0202312 | 3803 | 338 | 9263 | 2174 | 3W | S3B | 3Q | 9212 |
| * 0202331 | 4214 | 259 | 9539 | 2474 | 1Z | S3B | 7C | 9212 |
| * 0202333 | 4781 | 339 | 9263 | 2174 | 3W | S3B | 5Q | 9212 |
| * 0202358 | 5207 | 310 | 65885 | 3372 | 8P | | 7C | 9212 |
| * 0202394 | 3768 | 207 | 9539 | 2174 | 3W | S3B | 1W | 9212 |
| * 0202412 | 5144 | 528 | 9192 | 2174 | 3W | S3A | 3R | 9212 |
| * 0202443 | 5347 | 1362 | 65885 | 3372 | 3A | | 5C | 9212 |
| * 0201113 | 6057 | 143 | 9353 | 2474 | 1Z | S3B | 6F | 9301 |
| * 0201124 | 2757 | 227 | 9204 | 2474 | 5G | S3B | 1Z | 9301 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202012 | 5812 | 427 | 9287 | 2474 | 6F | S3B | 7D | 9301 |
| * 0202033 | 4600 | 293 | 65885 | 3372 | 5C | | 3U | 9301 |
| * 0202056 | 4292 | 692 | 9192 | 2474 | 7C | S3A | 3R | 9301 |
| * 0202081 | 5641 | 1283 | 65885 | 3372 | 3R | | 4P | 9301 |
| * 0202085 | 5412 | 554 | 9204 | 2474 | 4D | S3B | 3T | 9301 |
| * 0202102 | 5060 | 333 | 0421F | 2174 | 4D | S3B | 3A | 9301 |
| * 0202114 | 4210 | 651 | 0421F | 2174 | 4D | S3B | 7C | 9301 |
| * 0202114 | 4210 | 651 | 60200 | 2475 | 7C | | 7C | 9301 |
| * 0202123 | 5746 | 1255 | 9263 | 2174 | 3W | S3B | 7H | 9301 |
| * 0202210 | 3859 | 735 | 9298 | 2174 | 4D | S3A | 5G | 9301 |
| * 0202213 | 5868 | 347 | 9539 | 2474 | 1A | S3B | 3B | 9301 |
| * 0202219 | 4990 | 136 | 9298 | 2174 | 4D | S3A | 3R | 9301 |
| * 0202244 | 4892 | 401 | 9381 | 2474 | 4P | S3B | 3D | 9301 |
| * 0202275 | 4196 | 89 | 65885 | 2374 | 4D | S3B | 7D | 9301 |
| * 0202290 | 4812 | 227 | 9539 | 2474 | 5Q | S3B | 3Q | 9301 |
| * 0202298 | 4295 | 68 | 65885 | 3372 | 3A | | 7D | 9301 |
| * 0202340 | 4860 | 221 | 9739 | 2474 | 3M | S3B | 3T | 9301 |
| * 0202388 | 4186 | 700 | 52947 | 2474 | 7D | US3A | 2N | 9301 |
| * 0202416 | 4113 | 1280 | 9263 | 2174 | 3W | S3B | 3Q | 9301 |
| * 0201117 | 6415 | 15 | 55567 | 2474 | 3T | ES3A | 7C | 9302 |
| * 0201127 | 4828 | 3 | 9345 | 2474 | 3D | S3A | 4R | 9302 |
| * 0202003 | 5276 | 738 | 9572 | 2474 | 3R | S3B | 1G | 9302 |
| * 0202007 | 2311 | 0 | 3367 | 2475 | 3W | | 3T | 9302 |
| * 0202028 | 4694 | 517 | 9298 | 2474 | 6Q | S3B | 3T | 9302 |
| * 0202047 | 3512 | 210 | 9345 | 2474 | 1W | S3A | 1A | 9302 |
| * 0202053 | 6011 | 249 | 0421F | 2474 | 3R | ES3A | 3Q | 9302 |
| * 0202068 | 4683 | 236 | 55567 | 2474 | 5Q | ES3A | 7C | 9302 |
| * 0202086 | 2355 | 11 | 9226 | 2474 | 2S | S3B | 5W | 9302 |
| * 0202091 | 4676 | 614 | 9345 | 2474 | 2C | S3A | 6Q | 9302 |
| * 0202137 | 5361 | 2 | 0421F | 2474 | 3P | ES3A | 3P | 9302 |
| * 0202146 | 3575 | 2 | 61119 | 2475 | 7K | | 3B | 9302 |
| * 0202161 | 5472 | 957 | 55600 | 2474 | 3Q | S3B | 1Z | 9302 |
| * 0202179 | 4201 | 101 | 0421F | 2474 | 3M | S3B | 3W | 9302 |
| * 0202209 | 5335 | 814 | 9204 | 2474 | 5G | S3B | 3R | 9302 |
| * 0202211 | 4489 | 390 | 9381 | 2474 | 7A | S3B | 1Z | 9302 |
| * 0202230 | 5410 | 1244 | 9204 | 2474 | 5G | S3B | 3Q | 9302 |
| * 0202260 | 6536 | 918 | 9539 | 2474 | 1Z | S3B | 7C | 9302 |
| * 0202262 | 5445 | 409 | 9353 | 2474 | 3M | S3B | 3P | 9302 |
| * 0202283 | 4243 | 518 | 65885 | 3372 | 3A | | 5W | 9302 |
| * 0202315 | 4251 | 154 | 9353 | 2474 | 7C | S3B | 3T | 9302 |
| * 0202397 | 3118 | 972 | 65885 | 2374 | 3W | S3B | 3T | 9302 |
| * 0202415 | 4755 | 0 | 55600 | 2174 | 3W | S3B | 6P | 9302 |
| * 0202421 | 4244 | 798 | 55567 | 2474 | 5Q | ES3A | 7D | 9302 |
| * 0202434 | 3693 | 477 | 55567 | 2474 | 7C | ES3A | 7C | 9302 |
| * 0202007 | 2311 | 0 | 3367 | 2475 | 3W | | 3W | 9303 |
| * 0202031 | 6464 | 584 | 9381 | 2474 | 7C | S3B | 3T | 9303 |
| * 0202034 | 4141 | 1212 | 9353 | 2474 | 3Q | S3B | 5C | 9303 |
| * 0202049 | 6041 | 573 | 65885 | 3372 | 3R | | 5Q | 9303 |
| * 0202074 | 4266 | 49 | 9298 | 2174 | 3W | S3A | 3R | 9303 |
| * 0202101 | 5186 | 860 | 9539 | 2474 | 1Z | S3B | 3A | 9303 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202132 | 5510 | 1490 | 65885 | 3372 | 3R | | 2N | 9303 |
| * 0202137 | 5361 | 0 | 9539 | 2474 | 3P | S3B | 3B | 9303 |
| * 0202147 | 5555 | 390 | 9298 | 2474 | 2F | S3A | 6F | 9303 |
| * 0202158 | 5522 | 288 | 9204 | 2474 | 2N | S3B | 3B | 9303 |
| * 0202185 | 5221 | 1242 | 65885 | 3372 | 3R | | 5D | 9303 |
| * 0202262 | 5446 | 1 | 9539 | 2474 | 3P | S3B | 3B | 9303 |
| * 0202269 | 4479 | 567 | 65885 | 3372 | 6Q | | 5Q | 9303 |
| * 0202294 | 4750 | 887 | 9298 | 2474 | 6N | S3A | 5Q | 9303 |
| * 0202322 | 5098 | 998 | 9539 | 2474 | 1Z | S3B | 5Q | 9303 |
| * 0202334 | 5644 | 213 | 9539 | 2474 | 2N | S3B | 7D | 9303 |
| * 0202339 | 5894 | 1622 | 9353 | 2474 | 7C | S3B | 7C | 9303 |
| * 0202354 | 5522 | 34 | 9353 | 2174 | 3W | S3B | 1W | 9303 |
| * 0202360 | 4101 | 555 | 65885 | 3372 | 3R | | 3W | 9303 |
| * 0202369 | 5314 | 299 | 9287 | 2474 | 3Q | S3B | 7D | 9303 |
| * 0202373 | 4912 | 85 | 9539 | 2474 | 7C | S3B | 7D | 9303 |
| * 0202424 | 4980 | 469 | 9204 | 2474 | 5W | S3B | 2N | 9303 |
| * 0201119 | 5600 | 31 | 9263 | 2474 | 6F | S3B | 4P | 9304 |
| * 0201124 | 2800 | 43 | 9345 | 2174 | 3W | S3A | 5G | 9304 |
| * 0202018 | 4405 | 270 | 9298 | 2174 | 3W | S3A | 1Z | 9304 |
| * 0202065 | 3212 | 122 | 9287 | 2474 | 3Q | S3B | 3T | 9304 |
| * 0202131 | 6129 | 998 | 9629 | 2474 | 2N | S3B | 7D | 9304 |
| * 0202149 | 5675 | 1080 | 9539 | 2174 | 3W | S3B | 3W | 9304 |
| * 0202167 | 4492 | 470 | 9204 | 2474 | 5Q | S3B | 3T | 9304 |
| * 0202181 | 7157 | 230 | 9572 | 2174 | 3W | S3B | 6F | 9304 |
| * 0202189 | 5280 | 652 | 9298 | 2474 | 5Q | S3A | 7C | 9304 |
| * 0202192 | 5860 | 691 | 9629 | 2174 | 4D | S3B | 1W | 9304 |
| * 0202231 | 5378 | 527 | 65885 | 3372 | 3R | | 3R | 9304 |
| * 0202252 | 4334 | 1447 | 65885 | 3372 | 3R | | 7K | 9304 |
| * 0202257 | 6791 | 790 | 9572 | 2474 | 3T | S3B | 7C | 9304 |
| * 0202312 | 4022 | 557 | 9263 | 2474 | 2N | S3B | 3Q | 9304 |
| * 0202328 | 2746 | 521 | 9192 | 2474 | 7C | S3A | 3R | 9304 |
| * 0202333 | 4966 | 524 | 9345 | 2474 | 8B | S3B | 5Q | 9304 |
| * 0202338 | 4494 | 507 | 9739 | 2474 | 2C | S3B | 2C | 9304 |
| * 0202395 | 5291 | 1232 | 9298 | 2474 | 7C | S3A | 7C | 9304 |
| * 0202399 | 4793 | 863 | 52947 | 2474 | 7C | US3A | 6N | 9304 |
| * 0202410 | 5639 | 3 | 9539 | 2474 | 3T | S3B | 3B | 9304 |
| * 0201120 | 5464 | 423 | 55566 | 2474 | 3R | S3A | 6Q | 9305 |
| * 0202042 | 5784 | 178 | 9345 | 2474 | 1T | S3B | 7K | 9305 |
| * 0202047 | 3652 | 140 | 9298 | 2474 | 5Q | S3B | 1W | 9305 |
| * 0202101 | 5229 | 43 | 55566 | 2474 | 3R | ES3A | 3B | 9305 |
| * 0202106 | 3195 | 328 | 65885 | 2374 | 4D | S3B | 5Q | 9305 |
| * 0202169 | 5822 | 655 | 9381 | 2174 | 4D | S3B | 6A | 9305 |
| * 0202170 | 4255 | 1514 | 9204 | 2474 | 7C | S3B | 7G | 9305 |
| * 0202181 | 7182 | 255 | 9572 | 2174 | 3W | S3B | 6F | 9305 |
| * 0202192 | 5867 | 698 | 9539 | 2474 | 1Z | S3B | 1W | 9305 |
| * 0202206 | 5329 | 939 | 9739 | 2474 | 7C | S3B | 7D | 9305 |
| * 0202217 | 6422 | 946 | 9298 | 2474 | 7C | S3A | 3P | 9305 |
| * 0202225 | 7240 | 1092 | 9263 | 2474 | 7A | S3B | 7D | 9305 |
| * 0202264 | 5226 | 1102 | 9226 | 2474 | 7C | S3B | 3Q | 9305 |
| * 0202266 | 3731 | 173 | 65885 | 2374 | 4D | S3B | 4P | 9305 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202288 | 4211 | 934 | 0421F | 2474 | 3T | ES3A | 5G | 9305 |
| * 0202327 | 6781 | 172 | 9204 | 2474 | 7K | S3B | 4R | 9305 |
| * 0202335 | 5369 | 1298 | 9204 | 2174 | 4D | S3B | 6P | 9305 |
| * 0202386 | 5093 | 554 | 9345 | 2174 | 3W | S3A | 4B | 9305 |
| * 0202441 | 5938 | 551 | 9572 | 2174 | 3W | S3B | 7C | 9305 |
| * 0201117 | 6521 | 106 | 9353 | 2474 | 4B | S3B | 3B | 9306 |
| * 0202009 | 5997 | 89 | 9539 | 2474 | 5Q | S3B | 3B | 9306 |
| * 0202011 | 4051 | 3 | 65885 | 3372 | 3R |  | 3T | 9306 |
| * 0202022 | 5240 | 853 | 9572 | 2474 | 7C | S3B | 3T | 9306 |
| * 0202046 | 6591 | 661 | 55566 | 2174 | 3W | S3A | 7C | 9306 |
| * 0202078 | 3057 | 81 | 65885 | 2374 | 4D | S3A | 1Z | 9306 |
| * 0202116 | 5367 | 337 | 55566 | 2474 | 7K | ES3A | 7D | 9306 |
| * 0202163 | 3395 | 380 | 65885 | 2474 | 3R | S3A | 7C | 9306 |
| * 0202171 | 5063 | 69 | 9345 | 2474 | 2N | S3A | 8F | 9306 |
| * 0202198 | 5849 | 621 | 9345 | 2174 | 3W | S3A | 6A | 9306 |
| * 0202220 | 3760 | 731 | 9353 | 2474 | 8F | S3B | 7C | 9306 |
| * 0202226 | 4554 | 1149 | 9739 | 2474 | 3T | S3B | 3A | 9306 |
| * 0202227 | 5667 | 200 | 9353 | 2474 | 6N | S3B | 3Q | 9306 |
| * 0202259 | 4189 | 191 | 9345 | 2174 | 3W | S3B | 1T | 9306 |
| * 0202342 | 3540 | 43 | 9192 | 2474 | 3R | S3A | 5Q | 9306 |
| * 0202350 | 6161 | 1547 | 9353 | 2174 | 3W | S3B | 3Q | 9306 |
| * 0202365 | 6385 | 23 | 9739 | 2474 | 1A | S3B | 3A | 9306 |
| * 0202391 | 4207 | 632 | 9572 | 2474 | 7K | S3B | 4A | 9306 |
| * 0202398 | 5212 | 492 | 65885 | 2374 | 4D | S3A | 3R | 9306 |
| * 0202437 | 5398 | 380 | 9192 | 2474 | 3R | S3A | 3R | 9306 |
| * 0202458 | 201 |  | 9345 | 2174 | 3W | S3B |  | 9306 |
| * 0202458 | 201 |  | 9345 | 2174 | 3M | S3A |  | 9306 |
| * 0202459 | 53 |  | 9298 | 2174 | 3W | S3A |  | 9306 |
| * 0202027 | 6039 | 1627 | 9539 | 2474 | 7C | S3B | 3T | 9307 |
| * 0202037 | 4957 | 0 | 3366 | 2472 | 3W |  | 6F | 9307 |
| * 0202053 | 6243 | 232 | 9629 | 2474 | 8F | S3B | 3R | 9307 |
| * 0202078 | 3057 | 81 | 65885 | 3372 | 3R |  | 1Z | 9307 |
| * 0202080 | 6783 | 940 | 9287 | 2474 | 7C | S3B | 7C | 9307 |
| * 0202112 | 5196 | 1468 | 92685 | 2474 | 4B | S3A | 3T | 9307 |
| * 0202126 | 6789 | 1152 | 9204 | 2474 | 3T | S3B | 5Q | 9307 |
| * 0202137 | 5361 | 0 | 9353 | 2474 | 3P | S3B | 3P | 9307 |
| * 0202202 | 5566 | 530 | 65885 | 2374 | 4D | S3A | 7C | 9307 |
| * 0202224 | 5764 | 600 | 65885 | 3372 | 3R |  | 1Z | 9307 |
| * 0202301 | 3196 | 154 | 9192 | 2474 | 6N | S3A | 3B | 9307 |
| * 0202314 | 3849 | 1373 | 9353 | 2174 | 3W | S3B | 7L | 9307 |
| * 0202345 | 5658 | 1413 | 9739 | 2474 | 3R | S3B | 7C | 9307 |
| * 0202373 | 4975 | 63 | 9572 | 2474 | 3T | S3B | 7C | 9307 |
| * 0202398 | 5212 | 492 | 65885 | 3372 | 3R |  | 3R | 9307 |
| * 0202030 | 4972 | 1126 | 9192 | 2474 | 5Q | S3B | 1Z | 9308 |
| * 0202046 | 6639 | 709 | 55566 | 2474 | 7C | ES3A | 7C | 9308 |
| * 0202090 | 4509 | 1072 | 9629 | 2474 | 4B | S3B | 2C | 9308 |
| * 0202208 | 5348 | 699 | 55566 | 2474 | 8B | ES3A | 3Q | 9308 |
| * 0202284 | 4790 | 630 | 55566 | 2474 | 7C | S3A | 2N | 9308 |
| * 0202286 | 2554 | 686 | 55566 | 2174 | 3W | ES3A | 3D | 9308 |
| * 0202326 | 5406 | 323 | 9226 | 2474 | 4B | S3B | 1W | 9308 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202406 | 4216 | 566 | 9739 | 2474 | 1Z | S3B | 7K | 9308 |
| * 0202436 | 5385 | 1536 | 9739 | 2474 | 7C | S3B | 6F | 9308 |
| * 0202006 | 6106 | 668 | 9192 | 2474 | 6P | S3A | 7D | 9309 |
| * 0202007 | 2562 | 251 | 9287 | 2474 | 1Z | S3B | 3W | 9309 |
| * 0202083 | 4683 | 1135 | 9381 | 2474 | 1G | S3B | 2C | 9309 |
| * 0202088 | 5385 | 557 | 9287 | 2474 | 7C | S3B | 3R | 9309 |
| * 0202111 | 5749 | 995 | 9739 | 2474 | 5C | S3B | 7C | 9309 |
| * 0202128 | 4804 | 429 | 9287 | 2174 | 3W | S3B | 7C | 9309 |
| * 0202136 | 6111 | 982 | 9226 | 2474 | 7C | S3B | 7D | 9309 |
| * 0202150 | 6748 | 231 | 9192 | 2174 | 3W | S3A | 6N | 9309 |
| * 0202156 | 6631 | 0 | 3366 | 2472 | 6A |  | 5W | 9309 |
| * 0202241 | 4981 | 204 | 55566 | 2474 | 5Q | S3A | 8B | 9309 |
| * 0202292 | 6532 | 802 | 9572 | 2474 | 5W | S3B | 7D | 9309 |
| * 0202306 | 4377 | 456 | 65885 | 2374 | 1Z | S3B | 7C | 9309 |
| * 0202336 | 5380 | 0 | 21297 | 2472 | 3W |  | 3R | 9309 |
| * 0202356 | 5409 | 436 | 9739 | 2174 | 3W | S3B | 1Z | 9309 |
| * 0202394 | 3800 | 239 | 65885 | 3372 | 1Z |  | 1W | 9309 |
| * 0202413 | 5031 | 523 | 9539 | 2474 | 1Z | S3B | 7C | 9309 |
| * 0201108 | 5485 | 465 | 9298 | 2474 | 5Q | S3A | 7C | 9310 |
| * 0201123 | 5661 | 703 | 9287 | 2474 | 7C | S3B | 7D | 9310 |
| * 0202063 | 3716 | 580 | 9629 | 2474 | 7C | S3B | 8C | 9310 |
| * 0202082 | 5091 | 1402 | 0421F | 2174 | 4D | S3B | 4D | 9310 |
| * 0202113 | 5051 | 0 | 3362 | 2472 | 3W |  | 1W | 9310 |
| * 0202123 | 6109 | 1618 | 9298 | 2474 | 7D | S3A | 7H | 9310 |
| * 0202134 | 5870 | 667 | 65885 | 2374 | 4D | S3B | 7C | 9310 |
| * 0202139 | 4938 | 280 | 0421F | 2174 | 4D | S3B | 7C | 9310 |
| * 0202151 | 4906 | 0 | 246 | 2472 | 6A |  | 4M | 9310 |
| * 0202218 | 4224 | 1395 | 55566 | 2474 | 7C | ES3A | 5C | 9310 |
| * 0202239 | 5286 | 691 | 9345 | 2474 | 6F | S3B | 9J | 9310 |
| * 0202242 | 6240 | 1456 | 9539 | 2474 | 1Z | S3B | 7C | 9310 |
| * 0202263 | 6348 | 576 | 55566 | 2174 | 3W | ES3A | 1Z | 9310 |
| * 0202265 | 4890 | 368 | A9028 | 2474 | 5Q | ES3A | 3B | 9310 |
| * 0202400 | 5271 | 808 | 9353 | 2474 | 6N | S3B | 7D | 9310 |
| * 0202416 | 4476 | 1643 | 9298 | 2474 | 7D | S3A | 3Q | 9310 |
| * 0202441 | 5946 | 559 | 65885 | 3372 | 1Z |  | 7C | 9310 |
| * 0201115 | 6379 | 1630 | 9739 | 2474 | 7C | S3B | 7C | 9311 |
| * 0202102 | 5527 | 800 | 9353 | 2474 | 8C | S3B | 3A | 9311 |
| * 0202128 | 4955 | 580 | 9287 | 2474 | 6N | S3B | 7C | 9311 |
| * 0202137 | 5361 | 0 | 9287 | 2474 | 3P | S3B | 3B | 9311 |
| * 0202166 | 5124 | 1115 | 9539 | 2474 | 3B | S3B | 3Q | 9311 |
| * 0202169 | 6178 | 1011 | 9204 | 2474 | 6N | S3B | 6A | 9311 |
| * 0202177 | 4972 | 1566 | 9381 | 2474 | 7C | S3B | 5C | 9311 |
| * 0202178 | 5853 | 599 | 9263 | 2174 | 3W | S3B | 5C | 9311 |
| * 0202207 | 6793 | 1474 | 9345 | 2474 | 7C | S3A | 1Z | 9311 |
| * 0202210 | 4294 | 1170 | 9263 | 2474 | 1A | S3B | 5G | 9311 |
| * 0202219 | 5426 | 572 | 9263 | 2474 | 7C | S3B | 3R | 9311 |
| * 0202261 | 6572 | 1088 | 9287 | 2174 | 3W | S3B | 7D | 9311 |
| * 0202270 | 5747 | 1631 | 9739 | 2474 | 7C | S3B | 5B | 9311 |
| * 0202304 | 4322 | 771 | 9629 | 2474 | 2N | S3B | 7D | 9311 |
| * 0202335 | 5609 | 1538 | 9381 | 2474 | 7C | S3B | 6P | 9311 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202368 | 4894 | 447 | 9345 | 2174 | 3W | S3B | 3T | 9311 |
| * 0202427 | 5240 | 700 | 9287 | 2474 | 7D | S3B | 2N | 9311 |
| * 0202443 | 5445 | 98 | A9028 | 2474 | 7K | ES3A | 3R | 9311 |
| * 0202444 | 6188 | 1017 | 9226 | 2474 | 7C | S3B | 5W | 9311 |
| * 0202445 | 383 | | 9345 | 2174 | 3W | S3B | | 9311 |
| * 0201110 | 5670 | 18 | 9381 | 2474 | 3T | S3B | 5Q | 9312 |
| * 0201111 | 6136 | 241 | 65885 | 2374 | 4D | S3B | 1B | 9312 |
| * 0201111 | 6136 | 241 | 65885 | 3372 | 3R | | 1B | 9312 |
| * 0201114 | 4781 | 0 | 21412 | 2472 | 6A | | 3A | 9312 |
| * 0201116 | 6067 | 1033 | 9298 | 2474 | 7C | S3A | 1Z | 9312 |
| * 0202069 | 5422 | 0 | 3369 | 2472 | 2Q | | 7K | 9312 |
| * 0202075 | 4219 | 1354 | 9226 | 2474 | 6N | S3B | 5C | 9312 |
| * 0202093 | 4613 | 703 | 65885 | 3372 | 3R | | 7C | 9312 |
| * 0202130 | 6920 | 782 | 9298 | 2474 | 7C | S3A | 7C | 9312 |
| * 0202138 | 4765 | 39 | 9539 | 2174 | 3W | S3B | 3B | 9312 |
| * 0202149 | 5745 | 1150 | 65885 | 2374 | 4D | S3B | 3W | 9312 |
| * 0202149 | 5745 | 1150 | 65885 | 3372 | 3R | | 3W | 9312 |
| * 0202198 | 6062 | 834 | 9345 | 2174 | 4D | S3B | 6A | 9312 |
| * 0202203 | 4823 | 496 | 9381 | 2474 | 3T | S3B | 7C | 9312 |
| * 0202251 | 2661 | 169 | 5556B | 2474 | 4P | ES3A | 4B | 9312 |
| * 0202257 | 6796 | 5 | 55567 | 2174 | 3W | ES3A | 3T | 9312 |
| * 0202259 | 4452 | 454 | 9345 | 2174 | 4D | S3B | 1T | 9312 |
| * 0202263 | 6402 | 630 | 55566 | 2474 | 7C | S3A | 1Z | 9312 |
| * 0202278 | 6307 | 822 | 9629 | 2474 | 7C | S3B | 1W | 9312 |
| * 0202299 | 6134 | 339 | 9298 | 2174 | 3W | S3A | 1T | 9312 |
| * 0202313 | 5650 | 547 | 55567 | 2174 | 3W | ES3A | 7D | 9312 |
| * 0202333 | 5292 | 326 | 9345 | 2474 | 3T | S3B | 7C | 9312 |
| * 0202397 | 3119 | 973 | 65885 | 2374 | 3W | S3B | 3T | 9312 |
| * 0202397 | 3119 | 973 | 65885 | 3372 | 3R | | 3T | 9312 |
| * 0202413 | 5033 | 2 | 9539 | 2474 | 3B | S3B | 3B | 9312 |
| * 0202419 | 2413 | 0 | 21412 | 2472 | 6A | | 2S | 9312 |
| * 0202420 | 5830 | 931 | 9263 | 2474 | 7C | S3B | 6F | 9312 |
| * 0201110 | 5696 | 26 | 9345 | 2174 | 3W | S3B | 3T | 9401 |
| * 0202010 | 4406 | 0 | 60200 | 2472 | 6A | | 3Q | 9401 |
| * 0202048 | 5509 | 472 | 9192 | 2174 | 3W | S3A | 3T | 9401 |
| * 0202063 | 3716 | 0 | 60200 | 2472 | 3B | | 7C | 9401 |
| * 0202064 | 5834 | 5 | 65885 | 3372 | 2S | | 7C | 9401 |
| * 0202103 | 2550 | 0 | 60200 | 2472 | 6A | | 7A | 9401 |
| * 0202119 | 4607 | 1497 | 9287 | 2474 | 3P | S3B | 7K | 9401 |
| * 0202138 | 4766 | 40 | 9226 | 2474 | 5Q | S3B | 3B | 9401 |
| * 0202164 | 6622 | 498 | 9539 | 2474 | 4R | S3B | 3B | 9401 |
| * 0202167 | 4898 | 406 | 9204 | 2474 | 1T | S3B | 5Q | 9401 |
| * 0202168 | 608 | 0 | 65885 | 3172 | 3R | | 4D | 9401 |
| * 0202189 | 5280 | 0 | 3362 | 2472 | 3W | | 5Q | 9401 |
| * 0202199 | 7725 | 1472 | 9263 | 2474 | 7C | S3B | 7C | 9401 |
| * 0202204 | 6388 | 1128 | 9192 | 2174 | 3W | S3B | 5B | 9401 |
| * 0202227 | 5667 | 200 | 9629 | 2174 | 3W | S3B | 3Q | 9401 |
| * 0202241 | 4981 | 0 | 61577 | 2472 | 6A | | 7K | 9401 |
| * 0202260 | 6901 | 365 | 9572 | 2474 | 3T | S3B | 1Z | 9401 |
| * 0202325 | 5554 | 1056 | 9539 | 2474 | 8F | S3B | 7D | 9401 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202348 | 5945 | 1390 | 9192 | 2174 | 3W | S3B | 7K | 9401 |
| * 0202357 | 3701 | 750 | 9287 | 2174 | 3W | S3B | 6P | 9401 |
| * 0202368 | 4970 | 523 | 9345 | 2174 | 4D | S3B | 3T | 9401 |
| * 0202381 | 3855 | 885 | 9345 | 2474 | 7C | S3B | 7C | 9401 |
| * 0202388 | 4824 | 638 | A9028 | 2474 | 1Z | ES3A | 7D | 9401 |
| * 0202401 | 5842 | 987 | 9629 | 2174 | 3W | S3B | 7D | 9401 |
| * 0202405 | 3768 | 89 | 9345 | 2174 | 3W | S3B | 7D | 9401 |
| * 0202421 | 4301 | 57 | 9192 | 2174 | 3W | S3A | 5Q | 9401 |
| * 0201120 | 5494 | 30 | 55566 | 2174 | 3W | S3A | 1Z | 9402 |
| * 0201128 | 2888 | 955 | 55566 | 2174 | 3W | S3A | 3Q | 9402 |
| * 0202005 | 5975 | 658 | 52947 | 2474 | 7C | US3A | 3T | 9402 |
| * 0202068 | 5022 | 338 | 9287 | 2474 | 1W | S3B | 5Q | 9402 |
| * 0202073 | 5783 | 1612 | 9572 | 2474 | 7C | S3B | 7C | 9402 |
| * 0202074 | 4867 | 650 | 9298 | 2474 | 7C | S3A | 3R | 9402 |
| * 0202117 | 4513 | 25 | 65885 | 2374 | 4D | S3B | 7C | 9402 |
| * 0202120 | 4254 | 849 | 9287 | 2474 | 7D | S3B | 3T | 9402 |
| * 0202238 | 5845 | 1143 | 55566 | 2174 | 3W | S3A | 6P | 9402 |
| * 0202261 | 6696 | 1212 | 9287 | 2474 | 1W | S3B | 7D | 9402 |
| * 0202271 | 7211 | 1221 | 9572 | 2474 | 7C | S3B | 5Q | 9402 |
| * 0202274 | 3766 | 246 | 9298 | 2474 | 1G | S3A | 7C | 9402 |
| * 0202286 | 2647 | 779 | 55566 | 2474 | 7C | S3A | 3D | 9402 |
| * 0202306 | 4377 | 456 | 65885 | 3372 | 1Z |  | 7C | 9402 |
| * 0202323 | 5750 | 1112 | 52947 | 2474 | 7C | US3A | 8P | 9402 |
| * 0202353 | 6591 | 1050 | 9226 | 2474 | 1G | S3B | 3Q | 9402 |
| * 0202358 | 5207 | 310 | 3362 | 2472 | 3W |  | 7C | 9402 |
| * 0202401 | 5842 | 987 | 9629 | 2474 | 7C | S3B | 7D | 9402 |
| * 0202407 | 6725 | 1612 | 9572 | 2474 | 7C | S3B | 7C | 9402 |
| * 0202439 | 5405 | 853 | 9192 | 2474 | 6F | S3B | 1Z | 9402 |
| * 0201124 | 2920 | 163 | 65885 | 3372 | 3R |  | 5G | 9403 |
| * 0202009 | 6390 | 482 | 9629 | 2474 | 7C | S3B | 3B | 9403 |
| * 0202012 | 6234 | 422 | 9572 | 2174 | 3W | S3B | 6F | 9403 |
| * 0202015 | 5191 | 830 | 65885 | 2374 | 4D | S3B | 1Z | 9403 |
| * 0202037 | 5283 | 326 | 9353 | 2474 | 5C | S3B | 3W | 9403 |
| * 0202063 | 3751 | 35 | 9287 | 2474 | 7K | S3B | 3B | 9403 |
| * 0202101 | 5477 | 248 | 5556B | 2474 | 6F | ES3A | 3R | 9403 |
| * 0202107 | 2327 | 1022 | 9381 | 2474 | 7D | S3B | 6K | 9403 |
| * 0202155 | 4777 | 0 | 20993 | 2472 | 3W |  | 5W | 9403 |
| * 0202181 | 7630 | 703 | 9572 | 2474 | 7C | S3B | 6F | 9403 |
| * 0202186 | 5071 | 612 | 52947 | 2474 | 7C | US3A | 3R | 9403 |
| * 0202260 | 6901 | 0 | 9572 | 2474 | 7K | S3B | 3T | 9403 |
| * 0202287 | 5538 | 1648 | 9298 | 2474 | 7C | S3B | 7C | 9403 |
| * 0202289 | 5497 | 661 | A7401 | 2474 | 8F | ES3A | 4B | 9403 |
| * 0202296 | 5788 | 23 | 65885 | 2374 | 3W | S3B | 2N | 9403 |
| * 0202313 | 5759 | 656 | 55567 | 2474 | 7C | ES3A | 7D | 9403 |
| * 0202490 | 0 |  | 21412 | 2472 | 3E |  |  | 9403 |
| * 0201102 | 6048 | 812 | 55567 | 2474 | 7C | ES3A | 1Z | 9404 |
| * 0201113 | 6780 | 723 | 9572 | 2474 | 7C | S3B | 3B | 9404 |
| * 0202055 | 6372 | 985 | 9298 | 2474 | 7C | S3B | 3T | 9404 |
| * 0202089 | 4987 | 16 | 9263 | 2474 | 5D | S3A | 6Q | 9404 |
| * 0202130 | 7004 | 84 | 9298 | 2474 | 3T | S3A | 7C | 9404 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202146 | 3573 | 55 | 52947 | 2474 | 1W | US3A | 3Q | 9404 |
| * 0202172 | 5743 | 355 | 65885 | 2374 | 4D | S3B | 7D | 9404 |
| * 0202172 | 5743 | 355 | 65885 | 3372 | 3R | | 7D | 9404 |
| * 0202278 | 6373 | 66 | 9287 | 2174 | 3W | S3B | 7C | 9404 |
| * 0202288 | 4696 | 485 | 9353 | 2474 | 1W | S3B | 5Q | 9404 |
| * 0202290 | 4889 | 77 | 9353 | 2174 | 3W | S3B | 5Q | 9404 |
| * 0202311 | 4370 | 618 | 65885 | 2374 | 4D | S3A | 5C | 9404 |
| * 0202344 | 5498 | 244 | 9739 | 2174 | 3W | S3B | 3B | 9404 |
| * 0202359 | 6137 | 1389 | 9263 | 2474 | 7C | S3B | 3T | 9404 |
| * 0202370 | 6407 | 523 | 9263 | 2174 | 3W | S3B | 7C | 9404 |
| * 0202410 | 5750 | 111 | 65885 | 2374 | 4D | S3B | 3T | 9404 |
| * 0202422 | 4336 | 647 | 9287 | 2174 | 3W | S3B | 7D | 9404 |
| * 0202449 | 0 | | 21412 | 2472 | 3W | | | 9404 |
| * 0201108 | 5020 | 629 | 9192 | 2474 | 7C | S3A | 2S | 9405 |
| * 0202027 | 6384 | 345 | 9629 | 2174 | 3W | S3B | 7C | 9405 |
| * 0202058 | 5164 | 99 | 65885 | 2374 | 3W | S3A | 4R | 9405 |
| * 0202067 | 3152 | 391 | 55567 | 2474 | 7C | ES3A | 3P | 9405 |
| * 0202075 | 4225 | 6 | 9539 | 2474 | 2N | S3B | 7C | 9405 |
| * 0202088 | 5692 | 307 | 9287 | 2474 | 7C | S3B | 7C | 9405 |
| * 0202155 | 4777 | 0 | 20993 | 2472 | 3W | | 3W | 9405 |
| * 0202173 | 4089 | 724 | 65885 | 3372 | 3R | | 3T | 9405 |
| * 0202182 | 6822 | 252 | 9539 | 2474 | 1Z | S3B | 7C | 9405 |
| * 0202189 | 5436 | 156 | 55566 | 2174 | 3W | ES3A | 5Q | 9405 |
| * 0202196 | 4778 | 503 | 9739 | 2174 | 3W | S3B | 3T | 9405 |
| * 0202227 | 5927 | 460 | 9629 | 2174 | 3W | S3B | 3Q | 9405 |
| * 0202236 | 7010 | 1198 | 9226 | 2474 | 3T | S3B | 1B | 9405 |
| * 0202247 | 5124 | 1503 | 9263 | 2474 | 7C | S3B | 6P | 9405 |
| * 0202248 | 4979 | 639 | 9381 | 2174 | 3W | S3B | 1Z | 9405 |
| * 0202272 | 5712 | 883 | 9204 | 2474 | 3R | S3B | 7D | 9405 |
| * 0202280 | 4499 | 531 | 9739 | 2474 | 7C | S3B | 6F | 9405 |
| * 0202282 | 6497 | 1251 | 55567 | 2474 | 7C | ES3A | 4P | 9405 |
| * 0202285 | 6620 | 1219 | 9381 | 2174 | 3W | S3B | 3D | 9405 |
| * 0202291 | 5302 | 1153 | 9381 | 2174 | 4D | S3B | 5C | 9405 |
| * 0202293 | 5399 | 611 | 9539 | 2474 | 5Q | S3B | 1Z | 9405 |
| * 0202308 | 4724 | 183 | 9192 | 2474 | 5W | S3B | 1Z | 9405 |
| * 0202335 | 5610 | 1 | 9263 | 2174 | 3W | S3A | 7C | 9405 |
| * 0202340 | 5195 | 335 | 9381 | 2174 | 3W | S3B | 3P | 9405 |
| * 0202377 | 5539 | 1070 | 9539 | 2474 | 7C | S3B | 7D | 9405 |
| * 0202379 | 4403 | 294 | 55566 | 2174 | 3W | S3A | 7D | 9405 |
| * 0202385 | 4840 | 786 | 55566 | 2474 | 7K | ES3A | 7D | 9405 |
| * 0202409 | 5845 | 747 | 9739 | 2474 | 7L | S3B | 8B | 9405 |
| * 0202455 | 878 | | 9381 | 2174 | 3W | S3B | | 9405 |
| * 0201021 | 3883 | 524 | 65885 | 2374 | 4D | S3A | 1Z | 9406 |
| * 0201102 | 6068 | 20 | 9539 | 2474 | 3T | S3B | 7C | 9406 |
| * 0201128 | 3016 | 1083 | 55566 | 2474 | 7C | S3A | 3Q | 9406 |
| * 0202062 | 6561 | 1534 | 9353 | 2474 | 7C | S3B | 7D | 9406 |
| * 0202070 | 5625 | 1235 | 9298 | 2474 | 7T | S3B | 5Q | 9406 |
| * 0202075 | 4225 | 0 | 9629 | 2474 | 3R | S3B | 8F | 9406 |
| * 0202098 | 4847 | 0 | 65885 | 2374 | 4D | S3B | 5C | 9406 |
| * 0202106 | 3395 | 528 | 9629 | 2174 | 4D | S3B | 5Q | 9406 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202106 | 3395 | 528 | 60200 | 2472 | 3B | | 5Q | 9406 |
| * 0202108 | 5255 | 340 | 9298 | 2474 | 1W | S3A | 3R | 9406 |
| * 0202119 | 4681 | 74 | 9287 | 2474 | 3D | S3B | 3P | 9406 |
| * 0202133 | 4369 | 592 | 9739 | 2474 | 7C | S3B | 1Z | 9406 |
| * 0202142 | 6285 | 205 | 9629 | 2174 | 3W | S3B | 5C | 9406 |
| * 0202210 | 4489 | 195 | 9192 | 2474 | 5C | S3B | 1A | 9406 |
| * 0202215 | 5508 | 493 | 5556C | 2174 | 4D | ES3A | 7D | 9406 |
| * 0202227 | 5927 | 460 | 9629 | 2474 | 3R | S3B | 3Q | 9406 |
| * 0202267 | 6593 | 840 | 9629 | 2474 | 3R | S3B | 3T | 9406 |
| * 0202271 | 7211 | 0 | 9353 | 2174 | 3W | S3B | 7C | 9406 |
| * 0202276 | 6324 | 439 | 65885 | 3372 | 3R | | 7C | 9406 |
| * 0202282 | 6497 | 0 | 9629 | 2474 | 3R | S3B | 7C | 9406 |
| * 0202291 | 5302 | 1153 | 9298 | 2474 | 1W | S3A | 5C | 9406 |
| * 0202315 | 4492 | 241 | 5556C | 2474 | 6N | ES3A | 3B | 9406 |
| * 0202355 | 5539 | 17 | 9263 | 2174 | 4D | S3A | 7C | 9406 |
| * 0202369 | 5323 | 9 | 65885 | 2374 | 4D | S3B | 7A | 9406 |
| * 0202374 | 4841 | 971 | 9353 | 2174 | 3W | S3B | 3B | 9406 |
| * 0202402 | 5671 | 197 | 5556C | 2474 | 2S | ES3A | 2N | 9406 |
| * 0202406 | 4430 | 214 | 9192 | 2474 | 6F | S3B | 1Z | 9406 |
| * 0202442 | 5080 | 0 | 3360 | 2472 | 3W | | 1G | 9406 |
| * 0202443 | 5642 | 197 | 5556B | 2474 | 7J | S3A | 7K | 9406 |
| * 0202457 | 253 | | 9298 | 2174 | 3W | S3A | | 9406 |
| * 0202466 | 0 | | 60200 | 2472 | 3B | | | 9406 |
| * 0201106 | 6419 | 556 | 9298 | 2474 | 7C | S3B | 3T | 9407 |
| * 0202032 | 5805 | 1320 | 55567 | 2474 | 7C | ES3A | 7D | 9407 |
| * 0202080 | 7223 | 440 | 9287 | 2474 | 7C | S3B | 7C | 9407 |
| * 0202096 | 3318 | 1282 | 65885 | 2374 | 4D | S3B | 3B | 9407 |
| * 0202150 | 7042 | 525 | 9192 | 2174 | 3W | S3B | 6N | 9407 |
| * 0202155 | 4836 | 59 | 55566 | 2474 | 3B | ES3A | 3W | 9407 |
| * 0202155 | 4386 | | 55566 | 2474 | 3B | ES3A | 3W | 9407 |
| * 0202167 | 4923 | 25 | 9263 | 2174 | 4D | S3B | 1T | 9407 |
| * 0202220 | 3774 | 14 | 65885 | 2374 | 4D | S3B | 8F | 9407 |
| * 0202223 | 7140 | 100 | 9381 | 2474 | 3T | S3B | 3R | 9407 |
| * 0202255 | 5891 | 1268 | 9192 | 2174 | 3W | S3B | 6F | 9407 |
| * 0202265 | 5161 | 271 | 52947 | 2474 | 5Q | US3A | 7K | 9407 |
| * 0202281 | 6295 | 341 | 9287 | 2474 | 7C | S3B | 3B | 9407 |
| * 0202284 | 4901 | 111 | 9739 | 2174 | 3W | S3B | 7D | 9407 |
| * 0202300 | 5414 | 1051 | 55567 | 2474 | 7C | ES3A | 3D | 9407 |
| * 0202301 | 3714 | 521 | 9192 | 2174 | 3W | S3B | 6N | 9407 |
| * 0202329 | 6795 | 824 | 9192 | 2474 | 3W | S3B | 7D | 9407 |
| * 0202351 | 6349 | 1177 | 9298 | 2474 | 1T | S3B | 8C | 9407 |
| * 0202356 | 5772 | 799 | 9739 | 2474 | 3T | S3B | 1Z | 9407 |
| * 0202412 | 5773 | 1157 | 9192 | 2174 | 3W | S3B | 3R | 9407 |
| * 0202438 | 5574 | 156 | 55566 | 2174 | 3W | S3A | 2N | 9407 |
| * 0202440 | 5871 | 722 | 55566 | 2174 | 3W | ES3A | 5C | 9407 |
| * 0202447 | 658 | | 9298 | 2174 | 3W | S3A | | 9407 |
| * 0202451 | 779 | | 9263 | 2174 | 4D | S3B | | 9407 |
| * 0202454 | 658 | | 9298 | 2174 | 3W | S3A | | 9407 |
| * 0202075 | 4239 | 14 | 9287 | 2474 | 8C | S3B | 3B | 9408 |
| * 0202103 | 2550 | 0 | 9353 | 2474 | 8B | S3B | 7A | 9408 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202164 | 6852 | 230 | 9287 | 2174 | 3W | S3B | 4R | 9408 |
| * 0202206 | 5329 | 0 | 246 | 2472 | | | 7C | 9408 |
| * 0202254 | 6670 | 748 | 65885 | 2374 | 3W | S3B | 5Q | 9408 |
| * 0202269 | 4479 | 0 | 246 | 2472 | 6A | | 3R | 9408 |
| * 0202299 | 6862 | 1067 | 9298 | 2474 | 7C | S3A | 1T | 9408 |
| * 0202354 | 6593 | 1105 | 9353 | 2474 | 7C | S3B | 1W | 9408 |
| * 0202391 | 4628 | 421 | 9298 | 2474 | 5D | S3B | 7K | 9408 |
| * 0202475 | 445 | | 9629 | 2474 | 2N | S3B | | 9408 |
| * 0202489 | 15 | | 9353 | 2174 | 3W | S3B | | 9408 |
| * 0201104 | 6416 | 1089 | 65885 | 2374 | 3R | S3B | 6J | 9409 |
| * 0201104 | 6416 | 1089 | 65885 | 3372 | 3R | | 6J | 9409 |
| * 0201114 | 5159 | 378 | 9572 | 2174 | 3W | S3B | 3A | 9409 |
| * 0202012 | 6559 | 747 | 9572 | 2474 | 6J | S3B | 6F | 9409 |
| * 0202086 | 2572 | 217 | 65885 | 2374 | 3W | S3B | 2S | 9409 |
| * 0202086 | 2572 | 217 | 65885 | 3372 | 6Q | | 2S | 9409 |
| * 0202103 | 2550 | 0 | 9353 | 2474 | 8B | S3B | 7A | 9409 |
| * 0202109 | 5019 | 1230 | 55567 | 2174 | 4D | ES3A | 2N | 9409 |
| * 0202134 | 5887 | 684 | 9353 | 2474 | 7C | S3B | 7C | 9409 |
| * 0202155 | 4386 | | 55566 | 2474 | 3B | ES3A | 3P | 9409 |
| * 0202183 | 7209 | 1585 | 9287 | 2174 | 4D | S3B | 1Z | 9409 |
| * 0202204 | 6388 | 1128 | 65888 | 3374 | 2Q | S3B | 5B | 9409 |
| * 0202215 | 5724 | 709 | 9298 | 2474 | 7C | S3B | 7D | 9409 |
| * 0202238 | 5893 | 1191 | 55566 | 2474 | 7C | S3A | 6P | 9409 |
| * 0202264 | 5453 | 227 | 9298 | 2474 | 3R | S3B | 7C | 9409 |
| * 0202272 | 5904 | 192 | 5556C | 2474 | 1Z | ES3A | 3R | 9409 |
| * 0202313 | 6150 | 391 | A7402 | 2474 | 7E | ES3A | 7D | 9409 |
| * 0202322 | 5675 | 577 | 9572 | 2474 | 5W | S3B | 1Z | 9409 |
| * 0202348 | 5945 | 1390 | 65888 | 3374 | 3R | S3B | 7K | 9409 |
| * 0202355 | 5904 | 382 | 55566 | 2474 | 1Z | S3A | 7C | 9409 |
| * 0202368 | 5225 | 778 | 9263 | 2474 | 7C | S3B | 3T | 9409 |
| * 0202379 | 4584 | 475 | 55566 | 2474 | 7C | ES3A | 7D | 9409 |
| * 0202386 | 5726 | 1187 | 9345 | 2474 | 3B | S3B | 4B | 9409 |
| * 0202416 | 4692 | 216 | 9345 | 2174 | 3W | S3B | 7C | 9409 |
| * 0202426 | 5523 | 0 | 246 | 2472 | 6A | | 3R | 9409 |
| * 0202440 | 5892 | 743 | 55566 | 2474 | 7C | S3A | 5C | 9409 |
| * 0202003 | 6103 | 827 | 9353 | 2174 | 3W | S3B | 3R | 9410 |
| * 0202007 | 3053 | 491 | 9629 | 2474 | 6J | S3B | 1Z | 9410 |
| * 0202097 | 4905 | 864 | 65885 | 2374 | 4D | S3B | 7C | 9410 |
| * 0202138 | 5168 | 402 | 9298 | 2474 | 6B | S3B | 5Q | 9410 |
| * 0202150 | 7042 | 525 | 9263 | 2174 | 3W | S3B | 6N | 9410 |
| * 0202151 | 5302 | 396 | 9345 | 2174 | 3W | S3B | 4M | 9410 |
| * 0202160 | 5754 | 874 | 9629 | 2474 | 7C | S3B | 5Q | 9410 |
| * 0202235 | 5780 | 730 | 9192 | 2174 | 3W | S3B | 5Q | 9410 |
| * 0202241 | 5363 | 382 | 9298 | 2174 | 3W | US3A | 6A | 9410 |
| * 0202248 | 5183 | 843 | 9381 | 2474 | 7K | S3B | 1Z | 9410 |
| * 0202278 | 6554 | 247 | 9287 | 2174 | 4D | S3B | 7C | 9410 |
| * 0202285 | 6771 | 1370 | 9263 | 2474 | 5C | S3B | 3D | 9410 |
| * 0202339 | 6364 | 470 | 9353 | 2474 | 3P | S3B | 7D | 9410 |
| * 0202375 | 5946 | 579 | 5556D | 2174 | 4D | ES3A | 3T | 9410 |
| * 0202378 | 5917 | 838 | 9298 | 2174 | 3W | S3B | 3B | 9410 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202403 | 5937 | 910 | 9298 | 2474 | 3W | S3B | 3R | 9410 |
| * 0202407 | 6998 | 273 | 9572 | 2474 | 5Q | S3B | 7D | 9410 |
| * 0202410 | 5765 | 126 | 9353 | 2174 | 3W | S3B | 3T | 9410 |
| * 0202009 | 6390 | 482 | 3369 | 2472 | 6N | | 3B | 9411 |
| * 0202051 | 4688 | 570 | 65885 | 2374 | 4D | S3B | 3B | 9411 |
| * 0202097 | 4905 | 864 | 65885 | 3372 | 3R | | 7C | 9411 |
| * 0202157 | 4566 | 1148 | 9226 | 2474 | 5Q | S3B | 8B | 9411 |
| * 0202192 | 6033 | 166 | 9629 | 2474 | 7C | S3B | 1Z | 9411 |
| * 0202198 | 6290 | 1062 | 9263 | 2174 | 3W | S3B | 6A | 9411 |
| * 0202202 | 5683 | 647 | 9204 | 2474 | 7C | S3B | 7C | 9411 |
| * 0202212 | 5881 | 498 | 65885 | 2374 | 3W | S3B | 2N | 9411 |
| * 0202212 | 5881 | 498 | 65885 | 3372 | 3R | | 2N | 9411 |
| * 0202241 | 5365 | 384 | 5556D | 2474 | 3T | ES3A | 6A | 9411 |
| * 0202280 | 4499 | 0 | 9298 | 2474 | 2F | S3B | 6A | 9411 |
| * 0202340 | 5413 | 553 | 9263 | 2474 | 7C | S3B | 3P | 9411 |
| * 0202363 | 5610 | 586 | A7403 | 2474 | 5C | ES3A | 3B | 9411 |
| * 0202373 | 5046 | 71 | 65885 | 2374 | 4D | S3B | 3T | 9411 |
| * 0202373 | 5046 | 71 | 65885 | 3372 | 3R | | 3T | 9411 |
| * 0202375 | 5946 | 579 | 9298 | 2474 | 3T | S3B | 3T | 9411 |
| * 0202393 | 5037 | 237 | 9298 | 2474 | 3D | S3B | 1Z | 9411 |
| * 0202477 | 939 | | 9298 | 2174 | 3W | S3B | | 9411 |
| * 0202048 | 5976 | 939 | 9192 | 2474 | 1Z | S3B | 3T | 9412 |
| * 0202156 | 6739 | 108 | A7403 | 2474 | 5W | ES3A | 5W | 9412 |
| * 0202174 | 7244 | 1167 | 9298 | 2474 | 7C | S3B | 3T | 9412 |
| * 0202185 | 5221 | 0 | 9192 | 2474 | 8B | S3B | 3R | 9412 |
| * 0202186 | 5228 | 157 | 9739 | 2474 | 3T | S3B | 7C | 9412 |
| * 0202206 | 5359 | 30 | 9298 | 2474 | 3T | S3B | 6A | 9412 |
| * 0202252 | 4337 | 3 | 9192 | 2174 | 3W | S3B | 3R | 9412 |
| * 0202290 | 5430 | 618 | 9298 | 2474 | 5Q | S3B | 5Q | 9412 |
| * 0202328 | 3381 | 635 | 9192 | 2474 | 5C | S3B | 7C | 9412 |
| * 0202348 | 5945 | 0 | 9298 | 2472 | | | 3R | 9412 |
| * 0202380 | 5910 | 766 | 9192 | 2474 | 6E | S3B | 3T | 9412 |
| * 0201101 | 5295 | 0 | 0428A | 2472 | 6A | | 6L | 9501 |
| * 0202003 | 6265 | 989 | 9629 | 2474 | 5Q | S3B | 3R | 9501 |
| * 0202022 | 5880 | 640 | 9298 | 2474 | 5Q | S3B | 3B | 9501 |
| * 0202027 | 6795 | 756 | 9629 | 2474 | 7C | S3B | 7C | 9501 |
| * 0202078 | 3439 | 382 | 9204 | 2474 | 7C | S3B | 3R | 9501 |
| * 0202082 | 5091 | 1402 | 0428A | 2472 | 4D | | 4D | 9501 |
| * 0202108 | 5637 | 382 | 9298 | 2474 | 7C | S3B | 3B | 9501 |
| * 0202109 | 5232 | 1443 | 9353 | 2474 | 6N | S3B | 2N | 9501 |
| * 0202117 | 4513 | 25 | 65885 | 2374 | 3R | S3B | 7C | 9501 |
| * 0202117 | 4513 | 25 | 65885 | 3372 | 3R | | 7C | 9501 |
| * 0202139 | 4938 | 280 | 0421F | 2472 | 3W | | 7C | 9501 |
| * 0202143 | 6424 | 1249 | 9629 | 2474 | 7C | S3B | 3B | 9501 |
| * 0202248 | 5183 | 843 | 246 | 2472 | 4R | | 1Z | 9501 |
| * 0202356 | 5801 | 29 | 9739 | 2474 | 3T | S3B | 3T | 9501 |
| * 0202376 | 6017 | 582 | 9204 | 2174 | 3W | S3B | 8C | 9501 |
| * 0202384 | 6239 | 1337 | 9353 | 2474 | 7C | S3B | 7C | 9501 |
| * 0202393 | 5040 | 3 | 9204 | 2474 | 3D | S3B | 3D | 9501 |
| * 0202416 | 4863 | 387 | 9345 | 2474 | 6J | S3B | 7C | 9501 |

# APPENDIX A. ENGINE REMOVAL DATA

| SERNO | FHSN | FHSR | REM-UIC | SSC | REASON REMOVAL | A/C | P/REASON REMOVAL | START DATE |
|---|---|---|---|---|---|---|---|---|
| * 0202450 | 1049 | | 9204 | 2474 | 1Z | S3B | | 9501 |
| * 0202456 | 1049 | | 9204 | 2474 | 1Z | S3B | | 9501 |
| * 0202466 | 252 | | A7403 | 2174 | 3W | ES3A | | 9501 |
| * 0202490 | 251 | | A7403 | 2174 | 3W | ES3A | | 9501 |
| * 0202088 | 6054 | 362 | 9287 | 2474 | 6F | S3B | 7C | 9502 |
| * 0202096 | 3318 | 1282 | 65885 | 2374 | 6R | S3B | 3B | 9502 |
| * 0202118 | 6118 | 1311 | 9353 | 2474 | 7C | S3B | 7C | 9502 |
| * 0202123 | 6375 | 266 | 55566 | 2474 | 3T | ES3A | 7D | 9502 |
| * 0202260 | 6901 | 0 | 65885 | 2374 | 6R | S3B | 7K | 9502 |
| * 0202378 | 6199 | 1120 | 9298 | 2474 | 7C | S3B | 3B | 9502 |
| * 0202399 | 5106 | 313 | 9739 | 2474 | 7C | S3B | 7C | 9502 |
| * 0202427 | 5253 | 13 | 9353 | 2474 | 1G | S3B | 7C | 9502 |

# APPENDIX B. FORMULAS AND SPREADSHEET PROCEDURES

## A. WEIBULL SPREADSHEET PROCEDURES FOR CHAPTER II

### 1. Weibull Formulas

The spreadsheet procedures for Table 1 on page 7 of this thesis are reviewed here to provide an understanding of the computations. To calculate theta and beta with respect to a Weibull distribution, for failure time $T \sim W(\theta,\beta)$, Microsoft Excel Goal Seeking was utilized using the following equations (1) - (6):[1]

$$\frac{\Sigma T_i^{\beta}}{N} = \left[\frac{1}{N-1}\left((\Sigma T^{2\beta}) - \frac{(\Sigma T_i^{\beta})^2}{N}\right)\right]^{0.5} \qquad (1)$$

Equation (1) represents beta (hat) and is the **"Trial"** argument for goal seeking. It is solved by an iterative solution process that is done by using a spreadsheet program. The **"To Value"** is the N value represented by equation (1). The **"Changing Cell"** is the beta variable for which Goal Seeking provides a solution. Essentially, Excel solves for beta based on N in equation (1) by varying beta until it reaches the N value.

Once beta is obtained, theta is solved using equation (2) below:

$$\left(\frac{\Sigma T_i^{\beta}}{N}\right)^{1/\beta} = \hat{\theta} \qquad (2)$$

That is, the solution for beta is automatically installed in equation (2) and theta is then solved. The statistical justification for using equations (1) and (2) to solve for theta and beta is given in Caudill's thesis. [Ref. 2]

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[1] Equations 1, 2, 3, 4, 5 were developed in Reference 2 and relate to equations 24, 25, 21, 22, 16 respectively.

## APPENDIX B. FORMULAS AND SPREADSHEET PROCEDURES

This now allows MTBF and Variance to be computed using equations (3) and (4) respectively:

$$MTBF = \theta\Gamma\left(1 + \frac{1}{\beta}\right) \tag{3}$$

$$\text{Variance (T)} = \theta^2 \left[ \Gamma\left(1 + \frac{2}{\beta}\right) - \Gamma^2\left(1 + \frac{1}{\beta}\right)\right] \tag{4}$$

All these formulas have been programmed into spreadsheet formulas and are solved quickly. The Gamma values that were utilized are listed on Table 8 and were inserted manually by the author. The standard deviation of T:

$$\sigma_T = \sqrt{Var(T)} = \theta \tag{5}$$

### 2. Non-Parametric Formulas

The formula used to obtain MTBF, equation (6), of the Non-Parametric values are a built-in statistical function in the spreadsheet. Therefore, the MTBF and the standard deviation were computed using spreadsheet functions. For example, the spreadsheet function, =AVG(*cell range*), computes the average for a defined range of values. The standard deviation was computed in the same fashion using the =STDEV(*cell range*) function.

$$MTBF = \frac{\sum_{i=1}^{N} T_i}{N} \tag{6}$$

## APPENDIX B. FORMULAS AND SPREADSHEET PROCEDURES

| n | Γ (n) | n | Γ (n) | n | Γ (n) | n | Γ (n) |
|---|---|---|---|---|---|---|---|
| 1.00 | 1.00000 | 1.25 | .90640 | 1.50 | .88623 | 1.75 | .91906 |
| 1.01 | .99433 | 1.26 | .90440 | 1.51 | .88659 | 1.76 | .92137 |
| 1.02 | .98884 | 1.27 | .90250 | 1.52 | .88704 | 1.77 | .92376 |
| 1.03 | .98355 | 1.28 | .90072 | 1.53 | .88757 | 1.78 | .92623 |
| 1.04 | .97844 | 1.29 | .89904 | 1.54 | .88818 | 1.79 | .92877 |
| 1.05 | .97350 | 1.30 | .89747 | 1.55 | .88887 | 1.80 | .93138 |
| 1.06 | .96874 | 1.31 | .89600 | 1.56 | .88964 | 1.81 | .93408 |
| 1.07 | .96415 | 1.32 | .89464 | 1.57 | .89049 | 1.82 | .93685 |
| 1.08 | .95973 | 1.33 | .89338 | 1.58 | .89142 | 1.83 | .93969 |
| 1.09 | .95546 | 1.34 | .89222 | 1.59 | .89243 | 1.84 | .94261 |
| 1.10 | .95135 | 1.35 | .89115 | 1.60 | .89352 | 1.85 | .94561 |
| 1.11 | .94739 | 1.36 | .89018 | 1.61 | .89468 | 1.86 | .94869 |
| 1.12 | .94359 | 1.37 | .88931 | 1.62 | .89592 | 1.87 | .95184 |
| 1.13 | .93993 | 1.38 | .88854 | 1.63 | .89724 | 1.88 | .95507 |
| 1.14 | .93642 | 1.39 | .88785 | 1.64 | .89864 | 1.89 | .95838 |
| 1.15 | .93304 | 1.40 | .88726 | 1.65 | .90012 | 1.90 | .96177 |
| 1.16 | .92980 | 1.41 | .88676 | 1.66 | .90167 | 1.91 | .96523 |
| 1.17 | .92760 | 1.42 | .88636 | 1.67 | .90330 | 1.92 | .96878 |
| 1.18 | .92373 | 1.43 | .88604 | 1.68 | .90500 | 1.93 | .97240 |
| 1.19 | .92088 | 1.44 | .88580 | 1.69 | .90678 | 1.94 | .97610 |
| 1.20 | .91817 | 1.45 | .88565 | 1.70 | .90864 | 1.95 | .97988 |
| 1.21 | .91558 | 1.46 | .88560 | 1.71 | .91057 | 1.96 | .98374 |
| 1.22 | .91311 | 1.47 | .88563 | 1.72 | .91258 | 1.97 | .98768 |
| 1.23 | .91075 | 1.48 | .88575 | 1.73 | .91466 | 1.98 | .99171 |
| 1.24 | .90852 | 1.49 | .88595 | 1.74 | .91683 | 1.99 | .99581 |
| | | | | | | 2.00 | 1.00000 |

$$\text{Values of } \Gamma(n) = \int_0^\infty \exp^{-x} x^{n-1} dx;\ \Gamma(n+1) = n\Gamma(n)$$

**Table 8. GAMMA Function**

# APPENDIX B. FORMULAS AND SPREADSHEET PROCEDURES

## B. SPREADSHEET PROCEDURES FOR A WEIBULL PDF GRAPH

These procedures apply to The Weibull PDF graph on page 11 of this thesis. Microsoft Excel has a built in Weibull function that will compute values of either the CDF or the PDF of a Weibull distribution when given the values of $\theta$ and $\beta$ and the argument value x. There are four arguments to enter, =WEIBULL(x, $\theta$, $\beta$,cumulative). The x argument denotes a value of time or a range of time values. If a PDF is desired, enter "false" in place of the cumulative argument. If a CDF is desired, enter "true" in place of the cumulative argument. This spreadsheet function can be applied to a range of failure times. The procedure described above can produce a quick graph for illustrating what failure time distribution an engine manager may be dealing with. If the $\theta$ and $\beta$ values are known, they can simply be entered into the spreadsheet Weibull function. If $\theta$ and $\beta$ are not known, they can be computed as described at the beginning of this appendix.

## C. SPREADSHEET PROCEDURES FOR SOLVING $t_0$

This section depicts the spreadsheet procedures for computing $t_0$ using Table 7, page 43 of this thesis. The procedure is similar to the procedure for the Weibull formulas using Goal Seek tools in Microsoft Excel. The best way to compute $t_0$ is to leave the data entry cell for $t_0$ blank or enter 1. Have the cell under trial selected. This cell contains the formula, equation (10), whereby the spreadsheet will iterate until a solution is found. Select Goal Seek under the tools menu. Since the "**Trial Cell**" was previously selected, the "**To Value**" is the $T_0$ argument, enter 1000. The "**Changing Cell**" is $t_0$ cell, highlight this cell, click OK. Goal Seek will iterate several times and insert a solution into the $t_0$ cell.

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0201021 | 3359 | 33 | 9572 | 2474 | 7K | S3B | 8910 |
| * 0201022 | 3076 | 301 | 9646 | 2474 | 3Q | S3A | 8910 |
| * 0201022 | 3115 | 39 | 9646 | 2474 | 8P | S3A | 9008 |
| * 0201101 | 4805 | 685 | 9739 | 2474 | 4P | S3A | 9002 |
| * 0201101 | 5295 | 490 | 9646 | 2474 | 1Z | S3B | 9109 |
| * 0201102 | 5148 | 310 | 9539 | 2474 | 4M | S3B | 9003 |
| * 0201102 | 5236 | 88 | 9739 | 2474 | 1Z | S3B | 9106 |
| * 0201102 | 6068 | 20 | 9539 | 2474 | 3T | S3B | 9406 |
| * 0201103 | 5428 | 1018 | 9287 | 2474 | 3D | S3B | 9012 |
| * 0201103 | 5431 | 3 | 9539 | 2474 | 5Q | S3B | 9108 |
| * 0201104 | 5166 | 293 | 65885 | 3372 | 3A | | 9004 |
| * 0201104 | 5327 | 161 | 9192 | 2474 | 6N | S3A | 9108 |
| * 0201104 | 6416 | 1089 | 65885 | 2374 | 3R | S3B | 9409 |
| * 0201104 | 6416 | 1089 | 65885 | 3372 | 3R | | 9409 |
| * 0201106 | 5833 | 994 | 9204 | 2474 | 2N | S3A | 9010 |
| * 0201108 | 5485 | 465 | 9298 | 2474 | 5Q | S3A | 9310 |
| * 0201109 | 3606 | 211 | 9298 | 2474 | 5C | S3A | 9002 |
| * 0201110 | 5431 | 1030 | 9353 | 2474 | 8B | S3B | 9106 |
| * 0201110 | 5652 | 221 | 55566 | 2474 | 3T | S3A | 9209 |
| * 0201110 | 5670 | 18 | 9381 | 2474 | 3T | S3B | 9312 |
| * 0201111 | 5539 | 271 | 9572 | 2474 | 7A | S3B | 9107 |
| * 0201111 | 5895 | 356 | 9287 | 2474 | 1B | S3B | 9209 |
| * 0201111 | 6136 | 241 | 65885 | 3372 | 3R | | 9312 |
| * 0201112 | 5189 | 927 | 9572 | 2474 | 3P | S3B | 9007 |
| * 0201112 | 5804 | 615 | 9539 | 2474 | 3Q | S3B | 9211 |
| * 0201113 | 5313 | 262 | 9353 | 2474 | 1Z | S3B | 9006 |
| * 0201113 | 5335 | 22 | 9539 | 2474 | 2N | S3B | 9103 |
| * 0201113 | 5914 | 579 | 9287 | 2474 | 6F | S3B | 9207 |
| * 0201113 | 6057 | 143 | 9353 | 2474 | 1Z | S3B | 9301 |
| * 0201114 | 4807 | 1100 | 55566 | 2474 | 3M | S3A | 9111 |
| * 0201116 | 5034 | 548 | 65885 | 2374 | 7H | S3A | 9106 |
| * 0201117 | 6415 | 15 | 55567 | 2474 | 3T | ES3A | 9302 |
| * 0201118 | 5056 | 67 | 9739 | 2474 | 6F | S3A | 9001 |
| * 0201119 | 5569 | 322 | 9287 | 2474 | 6Q | S3B | 9203 |
| * 0201119 | 5600 | 31 | 9263 | 2474 | 6F | S3B | 9304 |
| * 0201120 | 5041 | 15 | 9263 | 2474 | 6N | S3A | 9005 |
| * 0201120 | 5464 | 423 | 55566 | 2474 | 3R | S3A | 9305 |
| * 0201121 | 2913 | 1423 | 9539 | 2474 | 5Q | S3B | 9108 |
| * 0201124 | 2360 | 959 | 9263 | 2474 | 1G | S3A | 9106 |
| * 0201124 | 2530 | 170 | 9298 | 2474 | 1Z | S3B | 9203 |
| * 0201124 | 2920 | 163 | 65885 | 3372 | 3R | | 9403 |
| * 0201127 | 4525 | 294 | 9539 | 2474 | 4M | S3B | 9003 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0201127 | 4600 | 75 | 55566 | 2474 | 6F | S3A | 9202 |
| * 0201127 | 4825 | 225 | 9381 | 2474 | 4R | S3B | 9209 |
| * 0201127 | 4828 | 3 | 9345 | 2474 | 3D | S3A | 9302 |
| * 0202001 | 5199 | 1470 | 9226 | 2474 | 3T | S3B | 9208 |
| * 0202003 | 4538 | 822 | 9629 | 2474 | 1G | S3B | 9011 |
| * 0202003 | 5276 | 738 | 9572 | 2474 | 3R | S3B | 9302 |
| * 0202004 | 5774 | 692 | 9381 | 2474 | 3R | S3B | 9201 |
| * 0202005 | 4762 | 615 | 9381 | 2474 | 1Z | S3A | 8912 |
| * 0202005 | 5212 | 450 | 9298 | 2474 | 3Q | S3A | 9108 |
| * 0202005 | 5317 | 105 | 9263 | 2474 | 1W | S3A | 9201 |
| * 0202006 | 6106 | 668 | 9192 | 2474 | 6P | S3A | 9309 |
| * 0202007 | 2311 | 533 | 9226 | 2474 | 3T | S3B | 9206 |
| * 0202007 | 2562 | 251 | 9287 | 2474 | 1Z | S3B | 9309 |
| * 0202008 | 3505 | 51 | 9646 | 2474 | 3Q | S3B | 9107 |
| * 0202009 | 5251 | 406 | 9539 | 2474 | 1G | S3B | 9108 |
| * 0202009 | 5997 | 89 | 9539 | 2474 | 5Q | S3B | 9306 |
| * 0202010 | 4107 | 415 | 9226 | 2474 | 1G | S3B | 9004 |
| * 0202010 | 4406 | 299 | 9646 | 2474 | 3Q | S3B | 9110 |
| * 0202011 | 4048 | 358 | 9629 | 2474 | 3Q | S3B | 9201 |
| * 0202011 | 4051 | 3 | 65885 | 3372 | 3R | | 9306 |
| * 0202012 | 4532 | 385 | 9263 | 2474 | 6E | S3A | 9003 |
| * 0202012 | 5812 | 427 | 9287 | 2474 | 6F | S3B | 9301 |
| * 0202012 | 6559 | 747 | 9572 | 2474 | 6J | S3B | 9409 |
| * 0202014 | 3663 | 1353 | 55566 | 2474 | 6N | ES3A | 9212 |
| * 0202015 | 4361 | 1327 | 65885 | 3372 | 3A | | 9104 |
| * 0202016 | 5411 | 504 | 9204 | 2474 | 1Z | S3A | 9109 |
| * 0202018 | 4135 | 229 | 9204 | 2474 | 1Z | S3A | 8912 |
| * 0202022 | 4387 | 40 | 9739 | 2474 | 3T | S3A | 9006 |
| * 0202023 | 4757 | 770 | 9192 | 2474 | 3P | S3A | 9012 |
| * 0202023 | 5504 | 747 | 52947 | 2474 | 5Q | US3A | 9204 |
| * 0202024 | 3979 | 508 | 9204 | 2474 | 1W | S3A | 9002 |
| * 0202024 | 4778 | 67 | 52947 | 2474 | 3D | US3A | 9105 |
| * 0202024 | 4908 | 130 | 52947 | 2474 | 3P | US3A | 9202 |
| * 0202025 | 5229 | 954 | 9298 | 2474 | 5C | S3A | 9101 |
| * 0202025 | 5380 | 151 | 9298 | 2474 | 1W | S3A | 9201 |
| * 0202026 | 5538 | 516 | 9629 | 2474 | 1Z | S3A | 8912 |
| * 0202027 | 4412 | 1441 | 9192 | 2474 | 3T | S3A | 9003 |
| * 0202028 | 4177 | 998 | 9298 | 2174 | 5Q | S3A | 9111 |
| * 0202028 | 4177 | 998 | 9298 | 2474 | 5Q | S3A | 9112 |
| * 0202028 | 4694 | 517 | 9298 | 2474 | 6Q | S3B | 9302 |
| * 0202029 | 5509 | 975 | 9298 | 2474 | 2S | S3A | 9207 |
| * 0202030 | 3567 | 688 | 9263 | 2474 | 1Z | S3A | 9005 |

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202030 | 3846 | 279 | 9381 | 2474 | 1Z | S3A | 9010 |
| * 0202030 | 4972 | 1126 | 9192 | 2474 | 5Q | S3B | 9308 |
| * 0202031 | 5534 | 791 | 9298 | 2474 | 6F | S3A | 9007 |
| * 0202031 | 5880 | 346 | 9298 | 2474 | 5Q | S3A | 9112 |
| * 0202033 | 4307 | 1183 | 9287 | 2474 | 3A | S3B | 9003 |
| * 0202033 | 4600 | 293 | 65885 | 3372 | 5C | | 9301 |
| * 0202034 | 2929 | 155 | 9629 | 2474 | 5W | S3B | 8910 |
| * 0202034 | 4141 | 1212 | 9353 | 2474 | 3Q | S3B | 9303 |
| * 0202035 | 3213 | 595 | 9192 | 2474 | 3U | S3A | 9102 |
| * 0202035 | 3215 | 2 | 9739 | 2474 | 3A | S3B | 9110 |
| * 0202035 | 3297 | 82 | 9739 | 2474 | 1W | S3B | 9202 |
| * 0202036 | 6133 | 1066 | 9192 | 2474 | 3Q | S3A | 8910 |
| * 0202036 | 6666 | 1 | 52947 | 2474 | 5Q | US3A | 9107 |
| * 0202036 | 6786 | 120 | 52947 | 2474 | 2S | US3A | 9112 |
| * 0202036 | 7037 | 251 | 9192 | 2474 | 3T | S3A | 9208 |
| * 0202037 | 4957 | 2 | 9739 | 2474 | 6F | S3A | 9002 |
| * 0202037 | 5283 | 326 | 9353 | 2474 | 5C | S3B | 9403 |
| * 0202038 | 3566 | 942 | 9298 | 2474 | 1Z | S3A | 9010 |
| * 0202042 | 5606 | 596 | 9345 | 2474 | 3R | S3A | 9207 |
| * 0202042 | 5606 | 596 | 9263 | 2474 | 7K | S3B | 9212 |
| * 0202042 | 5784 | 178 | 9345 | 2474 | 1T | S3B | 9305 |
| * 0202045 | 2885 | 485 | 9572 | 2474 | 6J | S3B | 8910 |
| * 0202045 | 2929 | 44 | 9572 | 2474 | 3R | S3B | 9003 |
| * 0202045 | 3008 | 79 | 9539 | 2474 | 5Q | S3A | 9109 |
| * 0202045 | 3310 | 302 | 9539 | 2474 | 3R | S3B | 9208 |
| * 0202047 | 3512 | 210 | 9345 | 2474 | 1W | S3A | 9302 |
| * 0202047 | 3652 | 140 | 9298 | 2474 | 5Q | S3B | 9305 |
| * 0202048 | 5037 | 424 | 65885 | 3372 | 1W | | 9203 |
| * 0202049 | 5186 | 1320 | 65885 | 3372 | 5Q | | 9002 |
| * 0202049 | 5196 | 10 | 9539 | 2474 | 8P | S3A | 9008 |
| * 0202049 | 5468 | 272 | 9539 | 2474 | 5Q | S3A | 9108 |
| * 0202049 | 6041 | 573 | 65885 | 3372 | 3R | | 9303 |
| * 0202051 | 3605 | 480 | 65885 | 3372 | 3A | | 9101 |
| * 0202051 | 3989 | 384 | 9345 | 2474 | 6N | S3A | 9205 |
| * 0202051 | 4118 | 129 | 55567 | 2474 | 5Q | S3A | 9210 |
| * 0202052 | 4466 | 555 | 65885 | 3372 | 3A | | 9206 |
| * 0202053 | 5762 | 761 | 9287 | 2474 | 3Q | S3B | 9105 |
| * 0202053 | 6011 | 249 | 0421F | 2474 | 3R | ES3A | 9302 |
| * 0202053 | 6243 | 232 | 9629 | 2474 | 8F | S3B | 9307 |
| * 0202054 | 3314 | 656 | 9739 | 2474 | 5C | S3A | 9001 |
| * 0202054 | 3349 | 35 | 52947 | 2474 | 6F | US3A | 9006 |
| * 0202054 | 3814 | 465 | 52947 | 2474 | 3M | US3A | 9204 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202055 | 5376 | 592 | 52947 | 2474 | 7L | US3A | 9007 |
| * 0202055 | 5387 | 11 | 52947 | 2474 | 1W | US3A | 9009 |
| * 0202056 | 3600 | 1103 | 9192 | 2474 | 3R | S3A | 9203 |
| * 0202058 | 5065 | 320 | 9192 | 2474 | 4R | S3A | 9002 |
| * 0202060 | 4917 | 460 | 52947 | 2474 | 6M | US3A | 8910 |
| * 0202060 | 5339 | 422 | 9192 | 2474 | 3R | S3A | 9103 |
| * 0202062 | 4464 | 40 | 9353 | 2474 | 1W | S3A | 9002 |
| * 0202062 | 5027 | 563 | 65885 | 3372 | 3A | | 9106 |
| * 0202063 | 3016 | 722 | 421 | 2474 | 5D | S3A | 8911 |
| * 0202063 | 3131 | 115 | 9353 | 2474 | 7K | S3A | 9008 |
| * 0202063 | 3136 | 5 | 9629 | 2474 | 8C | S3B | 9103 |
| * 0202063 | 3751 | 35 | 9287 | 2474 | 7K | S3B | 9403 |
| * 0202064 | 5122 | 809 | 9204 | 2474 | 7A | S3A | 8912 |
| * 0202064 | 5834 | 5 | 65885 | 3372 | 2S | | 9401 |
| * 0202065 | 3090 | 436 | 9539 | 2474 | 8F | S3B | 9203 |
| * 0202065 | 3212 | 122 | 9287 | 2474 | 3Q | S3B | 9304 |
| * 0202067 | 2761 | 1096 | 9287 | 2474 | 3P | S3B | 9203 |
| * 0202068 | 4683 | 236 | 55567 | 2474 | 5Q | ES3A | 9302 |
| * 0202068 | 5022 | 338 | 9287 | 2474 | 1W | S3B | 9402 |
| * 0202069 | 5422 | 138 | 52947 | 2474 | 7K | US3A | 9205 |
| * 0202070 | 4390 | 3 | 9539 | 2474 | 5Q | S3B | 9201 |
| * 0202070 | 5625 | 1235 | 9298 | 2474 | 7T | S3B | 9406 |
| * 0202071 | 3941 | 176 | 9298 | 2174 | 5Q | S3A | 9111 |
| * 0202071 | 3942 | 177 | 9298 | 2174 | 5Q | S3A | 9112 |
| * 0202071 | 3943 | 178 | 9298 | 2474 | 1W | S3A | 9201 |
| * 0202072 | 3636 | 1638 | 9192 | 2474 | 5Q | S3A | 8910 |
| * 0202074 | 3558 | 199 | 9646 | 2474 | 2N | S3A | 9005 |
| * 0202074 | 4217 | 659 | 65885 | 3372 | 6Q | | 9204 |
| * 0202075 | 2865 | 1006 | 9298 | 2474 | 5C | S3A | 9010 |
| * 0202075 | 4219 | 1354 | 9226 | 2474 | 6N | S3B | 9312 |
| * 0202075 | 4225 | 6 | 9539 | 2474 | 2N | S3B | 9405 |
| * 0202075 | 4239 | 14 | 9287 | 2474 | 8C | S3B | 9408 |
| * 0202076 | 3715 | 83 | 9572 | 2474 | 2N | S3B | 9002 |
| * 0202076 | 4161 | 327 | 9298 | 2174 | 5Q | S3B | 9111 |
| * 0202078 | 2976 | 99 | 9298 | 2474 | 1Z | S3A | 9207 |
| * 0202078 | 3057 | 81 | 65885 | 3372 | 3R | | 9307 |
| * 0202080 | 5481 | 3 | 9629 | 2474 | 3P | S3A | 8911 |
| * 0202080 | 5483 | 2 | 9629 | 2474 | 3P | S3A | 8912 |
| * 0202081 | 5641 | 1283 | 65885 | 3372 | 3R | | 9301 |
| * 0202083 | 3548 | 405 | 9204 | 2474 | 2C | S3A | 9006 |
| * 0202083 | 4683 | 1135 | 9381 | 2474 | 1G | S3B | 9309 |
| * 0202084 | 6540 | 70 | 9192 | 2474 | 1B | S3A | 9206 |

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202085 | 4858 | 82 | 9298 | 2474 | 1W | S3A | 9005 |
| * 0202086 | 2080 | 116 | 9629 | 2474 | 3Q | S3B | 9003 |
| * 0202086 | 2147 | 67 | 9539 | 2474 | 3T | S3B | 9009 |
| * 0202086 | 2355 | 11 | 9226 | 2474 | 2S | S3B | 9302 |
| * 0202086 | 2572 | 217 | 65885 | 3372 | 6Q | | 9409 |
| * 0202087 | 4339 | 1285 | 9539 | 2474 | 5Q | S3A | 9103 |
| * 0202087 | 4406 | 67 | 9539 | 2474 | 5Q | S3A | 9109 |
| * 0202088 | 4828 | 912 | 9539 | 2474 | 3R | S3B | 9207 |
| * 0202089 | 4435 | 226 | 9298 | 2474 | 7A | S3A | 9007 |
| * 0202089 | 4442 | 7 | 9298 | 2474 | 7J | S3A | 9008 |
| * 0202089 | 4971 | 529 | 9298 | 2474 | 3Q | S3A | 9202 |
| * 0202089 | 4987 | 16 | 9263 | 2474 | 5D | S3A | 9404 |
| * 0202090 | 3437 | 376 | 9629 | 2474 | 1Z | S3B | 9101 |
| * 0202091 | 4062 | 168 | 9263 | 2474 | 1Z | S3A | 9012 |
| * 0202091 | 4062 | 168 | 9298 | 2474 | 5C | S3A | 9103 |
| * 0202091 | 4676 | 614 | 9345 | 2474 | 2C | S3A | 9302 |
| * 0202092 | 3475 | 228 | 9629 | 2474 | 1G | S3B | 9106 |
| * 0202093 | 4613 | 703 | 65885 | 3372 | 3R | | 9312 |
| * 0202095 | 5694 | 89 | 65885 | 3372 | 1Z | | 9101 |
| * 0202098 | 4246 | 333 | 9381 | 2474 | 7K | S3A | 9008 |
| * 0202098 | 4847 | 601 | 52947 | 2474 | 8B | US3A | 9110 |
| * 0202101 | 4326 | 852 | 65885 | 3372 | 3A | | 9002 |
| * 0202101 | 5186 | 860 | 9539 | 2474 | 1Z | S3B | 9303 |
| * 0202101 | 5229 | 43 | 55566 | 2474 | 3R | ES3A | 9305 |
| * 0202101 | 5477 | 248 | 5556B | 2474 | 6F | ES3A | 9403 |
| * 0202102 | 4727 | 921 | 65885 | 3372 | 3A | | 9003 |
| * 0202102 | 5527 | 800 | 9353 | 2474 | 8C | S3B | 9311 |
| * 0202106 | 2867 | 493 | 9287 | 2474 | 5Q | S3B | 9107 |
| * 0202106 | 3395 | 528 | 60200 | 2472 | 3B | | 9406 |
| * 0202107 | 1273 | 74 | 246 | 2475 | 3R | | 9003 |
| * 0202107 | 1305 | 32 | 246 | 2475 | 6K | | 9107 |
| * 0202108 | 5255 | 340 | 9298 | 2474 | 1W | S3A | 9406 |
| * 0202111 | 5749 | 995 | 9739 | 2474 | 5C | S3B | 9309 |
| * 0202113 | 4165 | 382 | 9263 | 2474 | 1Z | S3A | 9008 |
| * 0202113 | 5051 | 886 | 9381 | 2474 | 7K | S3B | 9206 |
| * 0202116 | 5367 | 337 | 55566 | 2474 | 7K | ES3A | 9306 |
| * 0202117 | 3939 | 1042 | 9226 | 2474 | 5Q | S3B | 9105 |
| * 0202119 | 4607 | 1497 | 9287 | 2474 | 3P | S3B | 9401 |
| * 0202119 | 4681 | 74 | 9287 | 2474 | 3D | S3B | 9406 |
| * 0202120 | 2920 | 660 | 60200 | 3172 | 5C | | 8912 |
| * 0202120 | 2994 | 74 | 9629 | 2474 | 8P | S3B | 9008 |
| * 0202120 | 3405 | 411 | 9572 | 2474 | 3T | S3B | 9203 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202121 | 5854 | 338 | 65885 | 3372 | 3A | | 9111 |
| * 0202122 | 4950 | 814 | 9539 | 2474 | 5Q | S3B | 9010 |
| * 0202122 | 5234 | 284 | 9629 | 2474 | 8F | S3B | 9212 |
| * 0202125 | 5802 | 704 | 52947 | 2474 | 7L | US3A | 8912 |
| * 0202125 | 6418 | 616 | 9204 | 2474 | 1Z | S3A | 9110 |
| * 0202126 | 6789 | 1152 | 9204 | 2474 | 3T | S3B | 9307 |
| * 0202127 | 5584 | 291 | 9263 | 2474 | 1Z | S3A | 8911 |
| * 0202127 | 5830 | 246 | 9629 | 2474 | 1Z | S3B | 9008 |
| * 0202127 | 5990 | 160 | 9629 | 2474 | 3Q | S3B | 9102 |
| * 0202127 | 6790 | 960 | 9381 | 2474 | 7K | S3B | 9209 |
| * 0202128 | 4375 | 557 | 65885 | 3372 | 1Z | | 9103 |
| * 0202128 | 4955 | 580 | 9287 | 2474 | 6N | S3B | 9311 |
| * 0202130 | 5239 | 681 | 9572 | 2474 | 1Z | S3B | 9102 |
| * 0202130 | 7004 | 84 | 9298 | 2474 | 3T | S3A | 9404 |
| * 0202131 | 4540 | 404 | 9226 | 2474 | 3Q | S3B | 9003 |
| * 0202131 | 6129 | 998 | 9629 | 2474 | 2N | S3B | 9304 |
| * 0202132 | 5510 | 1490 | 65885 | 3372 | 3R | | 9303 |
| * 0202133 | 3777 | 560 | 65885 | 3372 | 1Z | | 9102 |
| * 0202134 | 5203 | 1115 | 9226 | 2474 | 3Q | S3B | 9101 |
| * 0202137 | 4753 | 916 | 9739 | 2474 | 1Z | S3A | 9003 |
| * 0202137 | 4848 | 115 | 65885 | 3372 | 5W | | 9105 |
| * 0202137 | 5359 | 3 | 9539 | 2474 | 3P | S3B | 9212 |
| * 0202137 | 5361 | 2 | 0421F | 2474 | 3P | ES3A | 9302 |
| * 0202138 | 4726 | 1389 | 9287 | 2474 | 5Q | S3B | 9206 |
| * 0202138 | 4766 | 40 | 9226 | 2474 | 5Q | S3B | 9401 |
| * 0202139 | 4658 | 404 | 9539 | 2474 | 5Q | S3B | 9007 |
| * 0202140 | 2564 | 393 | 65885 | 3372 | 3A | | 9011 |
| * 0202141 | 4557 | 242 | 9539 | 2474 | 6F | S3A | 9105 |
| * 0202141 | 4946 | 389 | 9629 | 2474 | 3A | S3B | 9207 |
| * 0202142 | 5726 | 850 | 9646 | 2474 | 2N | S3B | 9102 |
| * 0202142 | 6080 | 354 | 65885 | 3372 | 2A | | 9210 |
| * 0202143 | 5175 | 1026 | 9739 | 2474 | 3P | S3B | 9202 |
| * 0202146 | 3518 | 892 | 9381 | 2474 | 5Q | S3A | 9010 |
| * 0202146 | 3575 | 2 | 61119 | 2475 | 7K | | 9302 |
| * 0202146 | 3573 | 55 | 52947 | 2474 | 1W | US3A | 9404 |
| * 0202147 | 5165 | 761 | 9263 | 2474 | 2F | S3A | 9110 |
| * 0202147 | 5555 | 390 | 9298 | 2474 | 2F | S3A | 9303 |
| * 0202149 | 4595 | 485 | 9539 | 2474 | 3A | S3B | 9003 |
| * 0202149 | 5745 | 1150 | 65885 | 3372 | 3R | | 9312 |
| * 0202151 | 4353 | 467 | 9192 | 2474 | 5D | S3A | 9003 |
| * 0202151 | 4906 | 553 | 9572 | 2474 | 7A | S3B | 9110 |
| * 0202154 | 5606 | 859 | 65885 | 3372 | 5C | | 9210 |

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202155 | 4072 | 143 | 9572 | 2474 | 1Z | S3B | 9008 |
| * 0202155 | 4836 | 59 | 55566 | 2474 | 3B | ES3A | 9407 |
| * 0202156 | 6631 | 90 | 9539 | 2474 | 5W | S3B | 9207 |
| * 0202157 | 3418 | 212 | 9629 | 2474 | 8B | S3B | 9111 |
| * 0202158 | 5234 | 202 | 9646 | 2474 | 3Q | S3A | 8912 |
| * 0202158 | 5522 | 288 | 9204 | 2474 | 2N | S3B | 9303 |
| * 0202160 | 4784 | 567 | 9353 | 2474 | 8P | S3B | 9106 |
| * 0202160 | 4818 | 34 | 9353 | 2474 | 3T | S3B | 9108 |
| * 0202160 | 4880 | 62 | 9539 | 2474 | 5Q | S3B | 9110 |
| * 0202161 | 4515 | 653 | 9287 | 2474 | 1Z | S3B | 9005 |
| * 0202161 | 5472 | 957 | 55600 | 2474 | 3Q | S3B | 9302 |
| * 0202163 | 3395 | 380 | 65885 | 2474 | 3R | S3A | 9306 |
| * 0202164 | 5017 | 337 | 65885 | 3372 | 3A | | 9004 |
| * 0202164 | 6124 | 1107 | 9539 | 2474 | 1Z | S3B | 9210 |
| * 0202164 | 6622 | 498 | 9539 | 2474 | 4R | S3B | 9401 |
| * 0202166 | 4009 | 250 | 9539 | 2474 | 3Q | S3B | 9106 |
| * 0202166 | 5124 | 1115 | 9539 | 2474 | 3B | S3B | 9311 |
| * 0202167 | 4022 | 937 | 9298 | 2474 | 1W | S3A | 9201 |
| * 0202167 | 4492 | 470 | 9204 | 2474 | 5Q | S3B | 9304 |
| * 0202167 | 4898 | 406 | 9204 | 2474 | 1T | S3B | 9401 |
| * 0202169 | 4625 | 114 | 421 | 2474 | 1Z | S3A | 9012 |
| * 0202169 | 6178 | 1011 | 9204 | 2474 | 6N | S3B | 9311 |
| * 0202171 | 4182 | 362 | 65885 | 3372 | 3A | | 9002 |
| * 0202171 | 4660 | 478 | 9263 | 2474 | 7K | S3A | 9107 |
| * 0202171 | 4974 | 314 | 9298 | 2474 | 1Z | S3A | 9209 |
| * 0202171 | 4994 | 20 | 9381 | 2474 | 8F | S3B | 9210 |
| * 0202171 | 5063 | 69 | 9345 | 2474 | 2N | S3A | 9306 |
| * 0202172 | 5743 | 355 | 65885 | 3372 | 3R | | 9404 |
| * 0202173 | 3010 | 1030 | 9539 | 2474 | 5Q | S3B | 9012 |
| * 0202173 | 3300 | 290 | 9539 | 2474 | 5Q | S3B | 9110 |
| * 0202173 | 3365 | 65 | 9539 | 2474 | 3T | S3B | 9203 |
| * 0202173 | 4089 | 724 | 65885 | 3372 | 3R | | 9405 |
| * 0202174 | 5997 | 1360 | 9298 | 2474 | 5C | S3A | 9104 |
| * 0202176 | 4008 | 11 | 9298 | 2474 | 2N | S3A | 8912 |
| * 0202178 | 5254 | 1062 | 9381 | 2474 | 5C | S3A | 9106 |
| * 0202179 | 4201 | 101 | 0421F | 2474 | 3M | S3B | 9302 |
| * 0202181 | 5997 | 1513 | 9539 | 2474 | 5Q | S3B | 9102 |
| * 0202181 | 6927 | 930 | 9539 | 2474 | 8B | S3B | 9205 |
| * 0202182 | 6570 | 1336 | 9353 | 2474 | 3M | S3B | 9205 |
| * 0202182 | 6822 | 252 | 9539 | 2474 | 1Z | S3B | 9405 |
| * 0202183 | 5624 | 1430 | 65885 | 3372 | 1Z | | 9109 |
| * 0202185 | 5221 | 1242 | 65885 | 3372 | 3R | | 9303 |

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202186 | 4357 | 381 | 52947 | 2474 | 2N | US3A | 9005 |
| * 0202186 | 4361 | 4 | 52947 | 2474 | 5Q | US3A | 9107 |
| * 0202186 | 4459 | 98 | 65885 | 3372 | 3A | | 9112 |
| * 0202188 | 5474 | 1373 | 9298 | 2474 | 2N | S3A | 9009 |
| * 0202188 | 6122 | 648 | 9192 | 2474 | 1Z | S3A | 9108 |
| * 0202189 | 5280 | 652 | 9298 | 2474 | 5Q | S3A | 9304 |
| * 0202192 | 5169 | 1932 | 9287 | 2474 | 2N | S3B | 9202 |
| * 0202192 | 5867 | 698 | 9539 | 2474 | 1Z | S3B | 9305 |
| * 0202195 | 4615 | 727 | 9298 | 2474 | 7K | S3B | 9207 |
| * 0202196 | 4275 | 1105 | 9298 | 2474 | 5W | S3B | 9204 |
| * 0202197 | 5577 | 1116 | 9629 | 2474 | 3Q | S3B | 9201 |
| * 0202197 | 5766 | 189 | 65885 | 3372 | 3R | | 9208 |
| * 0202201 | 4643 | 1482 | 9353 | 2474 | 5Q | S3B | 9005 |
| * 0202201 | 5568 | 925 | 9381 | 2474 | 5Q | S3B | 9211 |
| * 0202203 | 3448 | 679 | 9539 | 2474 | 1Z | S3B | 9007 |
| * 0202203 | 3495 | 47 | 9539 | 2474 | 5W | S3B | 9101 |
| * 0202203 | 4823 | 496 | 9381 | 2474 | 3T | S3B | 9312 |
| * 0202204 | 5260 | 804 | 9739 | 2474 | 5B | S3B | 9012 |
| * 0202204 | 6388 | 1128 | 65888 | 3374 | 2Q | S3B | 9409 |
| * 0202205 | 4933 | 914 | 65885 | 3372 | 1Z | | 9101 |
| * 0202205 | 5163 | 230 | 9192 | 2474 | 8F | S3A | 9206 |
| * 0202206 | 3892 | 57 | 52947 | 2474 | 3P | US3A | 9001 |
| * 0202207 | 5319 | 434 | 9539 | 2474 | 1Z | S3B | 9006 |
| * 0202208 | 4624 | 688 | 9381 | 2474 | 6Q | S3A | 9003 |
| * 0202208 | 4649 | 25 | 9192 | 2474 | 3R | S3A | 9009 |
| * 0202208 | 5348 | 699 | 55566 | 2474 | 8B | ES3A | 9308 |
| * 0202209 | 4521 | 401 | 52947 | 2474 | 6P | US3A | 9005 |
| * 0202210 | 4294 | 1170 | 9263 | 2474 | 1A | S3B | 9311 |
| * 0202210 | 4489 | 195 | 9192 | 2474 | 5C | S3B | 9406 |
| * 0202211 | 3413 | 62 | 9353 | 2474 | 3U | S3A | 9001 |
| * 0202211 | 4099 | 218 | 52947 | 2474 | 1Z | US3A | 9205 |
| * 0202211 | 4489 | 390 | 9381 | 2474 | 7A | S3B | 9302 |
| * 0202212 | 5383 | 320 | 9353 | 2474 | 2N | S3B | 9201 |
| * 0202213 | 5521 | 1316 | 9353 | 2474 | 6F | S3B | 9008 |
| * 0202213 | 5868 | 347 | 9539 | 2474 | 1A | S3B | 9301 |
| * 0202214 | 5431 | 459 | 9204 | 2474 | 3T | S3A | 9201 |
| * 0202217 | 5282 | 323 | 9298 | 2474 | 6J | S3A | 9104 |
| * 0202217 | 5476 | 194 | 9298 | 2474 | 3B | S3A | 9111 |
| * 0202219 | 4854 | 785 | 9345 | 2474 | 3R | S3A | 9109 |
| * 0202220 | 2913 | 315 | 9287 | 2474 | 1Z | S3B | 9001 |
| * 0202220 | 3029 | 116 | 9287 | 2474 | 3M | S3B | 9012 |
| * 0202220 | 3760 | 731 | 9353 | 2474 | 8F | S3B | 9306 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202223 | 6626 | 117 | 52947 | 2474 | 3R | US3A | 9005 |
| * 0202223 | 7040 | 414 | 65885 | 3372 | 3A | | 9210 |
| * 0202223 | 7140 | 100 | 9381 | 2474 | 3T | S3B | 9407 |
| * 0202224 | 5164 | 902 | 65885 | 3372 | 1Z | | 9101 |
| * 0202224 | 5764 | 600 | 65885 | 3372 | 3R | | 9307 |
| * 0202225 | 7240 | 1092 | 9263 | 2474 | 7A | S3B | 9305 |
| * 0202226 | 3405 | 361 | 65885 | 3372 | 3A | | 9005 |
| * 0202226 | 4554 | 1149 | 9739 | 2474 | 3T | S3B | 9306 |
| * 0202227 | 5467 | 958 | 9629 | 2474 | 1Z | S3B | 9103 |
| * 0202227 | 5667 | 200 | 9353 | 2474 | 6N | S3B | 9306 |
| * 0202227 | 5927 | 460 | 9629 | 2474 | 3R | S3B | 9406 |
| * 0202228 | 5768 | 817 | 55566 | 2474 | 6F | S3A | 9203 |
| * 0202228 | 5868 | 100 | 9298 | 2474 | 7A | S3B | 9209 |
| * 0202229 | 3871 | 399 | 9739 | 2474 | 5Q | S3A | 8910 |
| * 0202229 | 4097 | 226 | 65885 | 3372 | 1W | | 9203 |
| * 0202231 | 4851 | 1179 | 65885 | 3372 | 3A | | 9105 |
| * 0202231 | 5378 | 527 | 65885 | 3372 | 3R | | 9304 |
| * 0202232 | 5412 | 1514 | 65885 | 3372 | 3A | | 9101 |
| * 0202232 | 6418 | 1007 | 9192 | 2474 | 5Q | S3A | 9212 |
| * 0202233 | 5394 | 1370 | 9381 | 2474 | 1W | S3A | 9003 |
| * 0202233 | 5439 | 45 | 9298 | 2474 | 5D | S3A | 9008 |
| * 0202233 | 5634 | 195 | 9204 | 2474 | 8C | S3A | 9105 |
| * 0202234 | 3815 | 190 | 9192 | 2474 | 1Z | S3A | 9012 |
| * 0202234 | 4121 | 306 | 9204 | 2474 | 1W | S3A | 9110 |
| * 0202234 | 4206 | 85 | 52947 | 2474 | 5Q | US3A | 9205 |
| * 0202235 | 5045 | 832 | 52947 | 2474 | 2S | US3A | 9101 |
| * 0202235 | 5050 | 1 | 52947 | 2474 | 5Q | US3A | 9205 |
| * 0202236 | 5812 | 1350 | 9539 | 2474 | 7J | S3B | 9008 |
| * 0202236 | 7010 | 1198 | 9226 | 2474 | 3T | S3B | 9405 |
| * 0202237 | 4470 | 66 | 9298 | 2474 | 2S | S3A | 8912 |
| * 0202239 | 4367 | 896 | 9739 | 2474 | 5W | S3A | 9012 |
| * 0202239 | 4595 | 228 | 9739 | 2474 | 9J | S3B | 9207 |
| * 0202239 | 5286 | 691 | 9345 | 2474 | 6F | S3B | 9310 |
| * 0202241 | 4777 | 510 | 65885 | 3372 | 3A | | 9201 |
| * 0202241 | 4981 | 204 | 55566 | 2474 | 5Q | S3A | 9309 |
| * 0202242 | 6240 | 1456 | 9539 | 2474 | 1Z | S3B | 9310 |
| * 0202244 | 4892 | 401 | 9381 | 2474 | 4P | S3B | 9301 |
| * 0202247 | 3621 | 879 | 9646 | 2474 | 3Q | S3A | 9005 |
| * 0202248 | 4340 | 865 | 65885 | 3372 | 1Z | | 9205 |
| * 0202250 | 4946 | 733 | 52947 | 2474 | 5Q | US3A | 9012 |
| * 0202250 | 5015 | 69 | 52947 | 2474 | 5Q | US3A | 9103 |
| * 0202251 | 2661 | 169 | 5556B | 2474 | 4P | ES3A | 9312 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202252 | 4334 | 1447 | 65885 | 3372 | 3R | | 9304 |
| * 0202254 | 5922 | 149 | 9298 | 2474 | 5Q | S3A | 9202 |
| * 0202256 | 5258 | 216 | 9298 | 2474 | 6J | S3A | 9208 |
| * 0202257 | 6791 | 790 | 9572 | 2474 | 3T | S3B | 9304 |
| * 0202259 | 3098 | 304 | 9298 | 2474 | 1Z | S3A | 8911 |
| * 0202259 | 3994 | 896 | 9298 | 2474 | 3Q | S3A | 9201 |
| * 0202260 | 5618 | 1175 | 9539 | 2474 | 8C | S3B | 9010 |
| * 0202260 | 6536 | 918 | 9539 | 2474 | 1Z | S3B | 9302 |
| * 0202260 | 6901 | 365 | 9572 | 2474 | 3T | S3B | 9401 |
| * 0202261 | 5025 | 436 | 9539 | 2474 | 2S | S3B | 9007 |
| * 0202261 | 6696 | 1212 | 9287 | 2474 | 1W | S3B | 9402 |
| * 0202262 | 5036 | 696 | 9646 | 2474 | 3Q | S3A | 8911 |
| * 0202262 | 5445 | 409 | 9353 | 2474 | 3M | S3B | 9302 |
| * 0202262 | 5446 | 1 | 9539 | 2474 | 3P | S3B | 9303 |
| * 0202263 | 5772 | 530 | 9263 | 2474 | 1Z | S3A | 9109 |
| * 0202264 | 4124 | 78 | 9646 | 2474 | 3Q | S3B | 9104 |
| * 0202264 | 5453 | 227 | 9298 | 2474 | 3R | S3B | 9409 |
| * 0202265 | 4522 | 667 | 9539 | 2474 | 5Q | S3B | 9210 |
| * 0202265 | 4890 | 368 | A9028 | 2474 | 5Q | ES3A | 9310 |
| * 0202265 | 5161 | 271 | 52947 | 2474 | 5Q | US3A | 9407 |
| * 0202266 | 3218 | 882 | 421 | 2474 | 3P | S3A | 9006 |
| * 0202266 | 3557 | 339 | 9629 | 2474 | 1G | S3B | 9104 |
| * 0202267 | 5742 | 385 | 9646 | 2474 | 3Q | S3A | 9001 |
| * 0202267 | 5753 | 11 | 9353 | 2474 | 7K | S3B | 9108 |
| * 0202267 | 6593 | 840 | 9629 | 2474 | 3R | S3B | 9406 |
| * 0202268 | 5627 | 1199 | 9739 | 2474 | 1Z | S3B | 9204 |
| * 0202269 | 3912 | 332 | 9539 | 2474 | 5Q | S3B | 9102 |
| * 0202269 | 4479 | 567 | 65885 | 3372 | 6Q | | 9303 |
| * 0202271 | 5791 | 20 | 9263 | 2474 | 5C | S3A | 9003 |
| * 0202271 | 5791 | 20 | 9263 | 2474 | 5C | S3A | 9004 |
| * 0202271 | 5990 | 199 | 9629 | 2474 | 5Q | S3B | 9108 |
| * 0202272 | 5712 | 883 | 9204 | 2474 | 3R | S3B | 9405 |
| * 0202272 | 5904 | 192 | 5556C | 2474 | 1Z | ES3A | 9409 |
| * 0202273 | 5078 | 1291 | 65885 | 3372 | 3A | | 9201 |
| * 0202274 | 3766 | 246 | 9298 | 2474 | 1G | S3A | 9402 |
| * 0202276 | 6324 | 439 | 65885 | 3372 | 3R | | 9406 |
| * 0202278 | 5425 | 946 | 9572 | 2474 | 2N | S3B | 9002 |
| * 0202278 | 5470 | 45 | 9629 | 2474 | 3Q | S3B | 9005 |
| * 0202278 | 5485 | 15 | 9629 | 2474 | 8F | S3B | 9104 |
| * 0202280 | 3762 | 355 | 9287 | 2474 | 3A | S3B | 9110 |
| * 0202280 | 3968 | 206 | 9298 | 2474 | 6F | S3A | 9210 |
| * 0202281 | 4928 | 1555 | 65885 | 3372 | 3A | | 9002 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202281 | 4939 | 11 | 9629 | 2474 | 8P | S3B | 9008 |
| * 0202281 | 5954 | 1015 | 9646 | 2474 | 1Z | S3B | 9204 |
| * 0202282 | 5246 | 2 | 9646 | 2474 | 4P | S3A | 8912 |
| * 0202283 | 3718 | 570 | 9287 | 2474 | 2S | S3B | 9102 |
| * 0202283 | 3725 | 7 | 9572 | 2474 | 5W | S3B | 9109 |
| * 0202283 | 4243 | 518 | 65885 | 3372 | 3A | | 9302 |
| * 0202284 | 4160 | 399 | 9226 | 2474 | 2N | S3B | 9109 |
| * 0202285 | 5401 | 1249 | 9345 | 2474 | 3D | S3A | 9208 |
| * 0202288 | 4211 | 934 | 0421F | 2474 | 3T | ES3A | 9305 |
| * 0202288 | 4696 | 485 | 9353 | 2474 | 1W | S3B | 9404 |
| * 0202289 | 5497 | 661 | A7401 | 2474 | 8F | ES3A | 9403 |
| * 0202290 | 4214 | 422 | 9539 | 2474 | 3R | S3B | 9102 |
| * 0202290 | 4585 | 371 | 9572 | 2474 | 3Q | S3B | 9201 |
| * 0202290 | 4812 | 227 | 9539 | 2474 | 5Q | S3B | 9301 |
| * 0202291 | 4146 | 816 | 9572 | 2474 | 3R | S3B | 9005 |
| * 0202291 | 5302 | 1153 | 9298 | 2474 | 1W | S3A | 9406 |
| * 0202292 | 6532 | 802 | 9572 | 2474 | 5W | S3B | 9309 |
| * 0202293 | 4634 | 438 | 9353 | 2474 | 1Z | S3A | 9006 |
| * 0202293 | 4788 | 154 | 9353 | 2474 | 1Z | S3B | 9012 |
| * 0202293 | 5399 | 611 | 9539 | 2474 | 5Q | S3B | 9405 |
| * 0202294 | 3863 | 988 | 9539 | 2474 | 5Q | S3B | 8910 |
| * 0202294 | 4063 | 200 | 9298 | 2174 | 5Q | S3A | 9201 |
| * 0202294 | 4750 | 887 | 9298 | 2474 | 6N | S3A | 9303 |
| * 0202296 | 5268 | 778 | 9287 | 2474 | 5B | S3B | 9103 |
| * 0202296 | 5765 | 1275 | 9629 | 2474 | 8F | S3B | 9205 |
| * 0202297 | 5190 | 492 | 9298 | 2474 | 1W | S3A | 9201 |
| * 0202298 | 4227 | 521 | 63282 | 2474 | 3M | S3A | 9206 |
| * 0202298 | 4295 | 68 | 65885 | 3372 | 3A | | 9301 |
| * 0202299 | 5315 | 483 | 9739 | 2474 | 6F | S3A | 9002 |
| * 0202299 | 5795 | 480 | 52947 | 2474 | 7K | US3A | 9110 |
| * 0202300 | 3956 | 862 | 9572 | 2474 | 1Z | S3B | 9101 |
| * 0202300 | 4363 | 407 | 9646 | 2474 | 3D | S3B | 9110 |
| * 0202301 | 3042 | 1007 | 9739 | 2474 | 7K | S3B | 9206 |
| * 0202301 | 3196 | 154 | 9192 | 2474 | 6N | S3A | 9307 |
| * 0202302 | 5082 | 211 | 9381 | 2474 | 1G | S3A | 9006 |
| * 0202304 | 3304 | 290 | 9353 | 2474 | 1Z | S3B | 9006 |
| * 0202304 | 4322 | 771 | 9629 | 2474 | 2N | S3B | 9311 |
| * 0202305 | 4349 | 391 | 9287 | 2474 | 3Q | S3B | 9010 |
| * 0202305 | 5087 | 738 | 9192 | 2474 | 5Q | S3A | 9209 |
| * 0202306 | 3383 | 113 | 9629 | 2474 | 1Z | S3B | 9001 |
| * 0202306 | 3921 | 538 | 9539 | 2474 | 3D | S3A | 9108 |
| * 0202306 | 4377 | 456 | 65885 | 2374 | 1Z | S3B | 9309 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202306 | 4377 | 456 | 65885 | 3372 | 1Z | | 9402 |
| * 0202307 | 5843 | 1157 | 9353 | 2474 | 3Q | S3B | 9208 |
| * 0202308 | 4541 | 272 | 9298 | 2474 | 1Z | S3B | 9206 |
| * 0202308 | 4724 | 183 | 9192 | 2474 | 5W | S3B | 9405 |
| * 0202311 | 3752 | 27 | 9263 | 2474 | 5C | S3A | 9004 |
| * 0202312 | 3465 | 216 | 9629 | 2474 | 6Q | S3B | 9103 |
| * 0202312 | 4022 | 557 | 9263 | 2474 | 2N | S3B | 9304 |
| * 0202313 | 6150 | 391 | A7402 | 2474 | 7E | ES3A | 9409 |
| * 0202315 | 4097 | 357 | 9353 | 2474 | 3T | S3B | 9011 |
| * 0202315 | 4492 | 241 | 5556C | 2474 | 6N | ES3A | 9406 |
| * 0202317 | 4173 | 373 | 9345 | 2474 | 8B | S3A | 9110 |
| * 0202317 | 4238 | 65 | 9298 | 2474 | 1W | S3A | 9203 |
| * 0202317 | 4318 | 80 | 9739 | 2474 | 5C | S3B | 9208 |
| * 0202319 | 4970 | 268 | 9298 | 2474 | 1Z | S3A | 9003 |
| * 0202319 | 5303 | 333 | 9204 | 2474 | 3B | S3A | 9109 |
| * 0202319 | 5638 | 335 | 9739 | 2474 | 5Q | S3B | 9210 |
| * 0202321 | 4974 | 529 | 9539 | 2474 | 7K | S3B | 9205 |
| * 0202321 | 5074 | 99 | 9539 | 2474 | 1Z | S3B | 9209 |
| * 0202322 | 4100 | 189 | 9353 | 2474 | 5Q | S3B | 9009 |
| * 0202322 | 5098 | 998 | 9539 | 2474 | 1Z | S3B | 9303 |
| * 0202322 | 5675 | 577 | 9572 | 2474 | 5W | S3B | 9409 |
| * 0202323 | 4638 | 392 | 9353 | 2474 | 8P | S3B | 9009 |
| * 0202324 | 3986 | 860 | 9629 | 2474 | 5C | S3B | 8911 |
| * 0202325 | 5554 | 1056 | 9539 | 2474 | 8F | S3B | 9401 |
| * 0202326 | 4403 | 448 | 65885 | 3372 | 3A | | 9002 |
| * 0202326 | 5083 | 3 | 55566 | 2474 | 3T | S3A | 9203 |
| * 0202327 | 6609 | 513 | 9192 | 2474 | 4R | S3A | 9209 |
| * 0202327 | 6781 | 172 | 9204 | 2474 | 7K | S3B | 9305 |
| * 0202328 | 2225 | 394 | 52947 | 2474 | 3R | US3A | 9001 |
| * 0202330 | 5157 | 662 | 9192 | 2474 | 1Z | S3A | 9011 |
| * 0202331 | 3163 | 421 | 65885 | 3372 | 3A | | 9003 |
| * 0202331 | 4214 | 259 | 9539 | 2474 | 1Z | S3B | 9212 |
| * 0202333 | 4442 | 1121 | 9263 | 2474 | 5Q | S3A | 9201 |
| * 0202333 | 4966 | 524 | 9345 | 2474 | 8B | S3B | 9304 |
| * 0202333 | 5292 | 326 | 9345 | 2474 | 3T | S3B | 9312 |
| * 0202334 | 5644 | 213 | 9539 | 2474 | 2N | S3B | 9303 |
| * 0202336 | 4776 | 179 | 9572 | 2474 | 8F | S3B | 8910 |
| * 0202336 | 5155 | 15 | 9629 | 2474 | 3Q | S3B | 9104 |
| * 0202336 | 5380 | 225 | 65885 | 3372 | 3A | | 9208 |
| * 0202338 | 3987 | 309 | 9381 | 2474 | 8C | S3A | 9010 |
| * 0202338 | 4494 | 507 | 9739 | 2474 | 2C | S3B | 9304 |
| * 0202340 | 4595 | 227 | 52947 | 2474 | 5W | US3A | 9101 |

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202340 | 4615 | 20 | 52947 | 2474 | 2P | US3A | 9103 |
| * 0202340 | 4619 | 4 | 9739 | 2474 | 1W | S3B | 9112 |
| * 0202340 | 4860 | 221 | 9739 | 2474 | 3M | S3B | 9301 |
| * 0202342 | 2825 | 42 | 52947 | 2474 | 6T | US3A | 9005 |
| * 0202342 | 2827 | 2 | 52947 | 2474 | 7K | US3A | 9101 |
| * 0202342 | 3497 | 670 | 52947 | 2474 | 5Q | US3A | 9205 |
| * 0202342 | 3540 | 43 | 9192 | 2474 | 3R | S3A | 9306 |
| * 0202343 | 5630 | 893 | 9345 | 2474 | 3T | S3A | 9204 |
| * 0202345 | 5658 | 1413 | 9739 | 2474 | 3R | S3B | 9307 |
| * 0202346 | 4314 | 19 | 9353 | 2474 | 5W | S3B | 9008 |
| * 0202346 | 4315 | 1 | 9539 | 2474 | 5W | S3B | 9101 |
| * 0202346 | 4799 | 484 | 55567 | 2474 | 3Q | S3A | 9206 |
| * 0202347 | 3610 | 492 | 9539 | 2474 | 2N | S3A | 9011 |
| * 0202347 | 4196 | 586 | 9381 | 2474 | 6Q | S3B | 9206 |
| * 0202348 | 4555 | 96 | 9263 | 2474 | 7K | S3A | 9003 |
| * 0202348 | 5945 | 1390 | 65888 | 3374 | 3R | S3B | 9409 |
| * 0202351 | 5172 | 1097 | 9381 | 2474 | 8C | S3B | 9207 |
| * 0202351 | 6349 | 1177 | 9298 | 2474 | 1T | S3B | 9407 |
| * 0202353 | 5541 | 1062 | 9353 | 2474 | 3Q | S3B | 9203 |
| * 0202353 | 6591 | 1050 | 9226 | 2474 | 1G | S3B | 9402 |
| * 0202354 | 4883 | 1450 | 65885 | 3372 | 1Z | | 9011 |
| * 0202354 | 5488 | 605 | 9629 | 2474 | 8F | S3B | 9205 |
| * 0202355 | 4491 | 1 | 9298 | 2474 | 3Q | S3A | 9005 |
| * 0202355 | 5522 | 1031 | 9345 | 2474 | 7K | S3A | 9209 |
| * 0202355 | 5904 | 382 | 55566 | 2474 | 1Z | S3A | 9409 |
| * 0202356 | 4456 | 581 | 9381 | 2474 | 3Q | S3A | 8910 |
| * 0202356 | 4658 | 202 | 9204 | 2474 | 1G | S3A | 9004 |
| * 0202356 | 4973 | 315 | 65885 | 3372 | 1Z | | 9202 |
| * 0202356 | 5772 | 799 | 9739 | 2474 | 3T | S3B | 9407 |
| * 0202358 | 5207 | 310 | 65885 | 3372 | 8P | | 9212 |
| * 0202359 | 4736 | 355 | 52947 | 2474 | 8C | US3A | 9009 |
| * 0202359 | 4748 | 12 | 52947 | 2474 | 3T | US3A | 9101 |
| * 0202360 | 3352 | 193 | 9353 | 2474 | 1G | S3A | 9001 |
| * 0202360 | 3546 | 387 | 9572 | 2474 | 3P | S3B | 9006 |
| * 0202360 | 4101 | 555 | 65885 | 3372 | 3R | | 9303 |
| * 0202361 | 3295 | 484 | 9353 | 2474 | 1W | S3A | 9001 |
| * 0202362 | 4576 | 819 | 55600 | 2474 | 3Q | S3B | 9208 |
| * 0202363 | 4001 | 888 | 9226 | 2474 | 1Z | S3B | 9004 |
| * 0202363 | 4280 | 279 | 9646 | 2474 | 7K | S3B | 9012 |
| * 0202363 | 5024 | 274 | 9539 | 2474 | 5Q | S3B | 9209 |
| * 0202364 | 5343 | 1084 | 9298 | 2474 | 6J | S3A | 9104 |
| * 0202364 | 5395 | 52 | 9298 | 2174 | 5Q | S3A | 9111 |

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202364 | 5398 | 55 | 9298 | 2474 | 5Q | S3B | 9112 |
| * 0202365 | 6022 | 745 | 9298 | 2474 | 6J | S3A | 9104 |
| * 0202365 | 6362 | 340 | 9739 | 2474 | 6N | S3B | 9203 |
| * 0202365 | 6385 | 23 | 9739 | 2474 | 1A | S3B | 9306 |
| * 0202366 | 4428 | 56 | 9298 | 2474 | 2C | S3A | 9007 |
| * 0202366 | 4968 | 540 | 9298 | 2474 | 5Q | S3A | 9201 |
| * 0202367 | 4118 | 46 | 52947 | 2474 | 8C | US3A | 9005 |
| * 0202367 | 4201 | 83 | 52947 | 2474 | 1G | US3A | 9104 |
| * 0202368 | 3690 | 176 | 9192 | 2474 | 5C | S3A | 8910 |
| * 0202368 | 4447 | 757 | 9298 | 2474 | 1W | S3A | 9201 |
| * 0202369 | 5314 | 299 | 9287 | 2474 | 3Q | S3B | 9303 |
| * 0202370 | 4750 | 263 | 9739 | 2474 | 6F | S3A | 8911 |
| * 0202370 | 5368 | 618 | 52947 | 2474 | 3T | US3A | 9012 |
| * 0202373 | 3958 | 333 | 9226 | 2474 | 1G | S3B | 9003 |
| * 0202373 | 4975 | 63 | 9572 | 2474 | 3T | S3B | 9307 |
| * 0202374 | 3838 | 1018 | 9287 | 2474 | 5Q | S3B | 9108 |
| * 0202374 | 3870 | 32 | 9226 | 2474 | 5Q | S3B | 9206 |
| * 0202375 | 5367 | 806 | 9298 | 2474 | 6P | S3A | 9109 |
| * 0202376 | 5435 | 188 | 9226 | 2474 | 8C | S3B | 9205 |
| * 0202377 | 3701 | 609 | 9226 | 2474 | 3Q | S3B | 9001 |
| * 0202377 | 4178 | 477 | 9539 | 2474 | 3P | S3B | 9104 |
| * 0202377 | 4469 | 291 | 9572 | 2474 | 2S | S3B | 9202 |
| * 0202378 | 4138 | 230 | 9298 | 2474 | 3Q | S3A | 9006 |
| * 0202378 | 5079 | 941 | 9287 | 2474 | 3Q | S3B | 9210 |
| * 0202379 | 3804 | 1617 | 9539 | 2474 | 1C | S3B | 9006 |
| * 0202380 | 4716 | 953 | 9263 | 2474 | 1Z | S3A | 9005 |
| * 0202380 | 5144 | 428 | 9298 | 2474 | 8P | S3A | 9106 |
| * 0202383 | 4488 | 704 | 52947 | 2474 | 1Z | US3A | 9003 |
| * 0202383 | 4497 | 9 | 52947 | 2474 | 6F | US3A | 9104 |
| * 0202384 | 4630 | 1218 | 9539 | 2474 | 2N | S3B | 9201 |
| * 0202384 | 4902 | 272 | 9629 | 2474 | 7K | S3B | 9211 |
| * 0202385 | 4840 | 786 | 55566 | 2474 | 7K | ES3A | 9405 |
| * 0202386 | 4520 | 126 | 9204 | 2474 | 1Z | S3A | 8910 |
| * 0202386 | 4539 | 19 | 9263 | 2474 | 2A | S3A | 9006 |
| * 0202386 | 5726 | 1187 | 9345 | 2474 | 3B | S3B | 9409 |
| * 0202388 | 4824 | 638 | A9028 | 2474 | 1Z | ES3A | 9401 |
| * 0202390 | 4825 | 347 | 9646 | 2474 | 7A | S3A | 9002 |
| * 0202391 | 3575 | 417 | 9263 | 2474 | 4P | S3A | 9105 |
| * 0202391 | 4207 | 632 | 9572 | 2474 | 7K | S3B | 9306 |
| * 0202391 | 4628 | 421 | 9298 | 2474 | 5D | S3B | 9408 |
| * 0202392 | 2619 | 55 | 246 | 2475 | 3R | | 9003 |
| * 0202393 | 4800 | 667 | 52947 | 2474 | 1Z | US3A | 8911 |

# APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202393 | 5032 | 232 | 9298 | 2474 | 6J | S3A | 9207 |
| * 0202394 | 3561 | 1063 | 9226 | 2474 | 2N | S3B | 9204 |
| * 0202394 | 3800 | 239 | 65885 | 3372 | 1Z | | 9309 |
| * 0202397 | 2146 | 215 | 9226 | 2474 | 3T | S3B | 9008 |
| * 0202397 | 3119 | 973 | 65885 | 3372 | 3R | | 9312 |
| * 0202398 | 4720 | 1598 | 9298 | 2474 | 3R | S3A | 9102 |
| * 0202398 | 4898 | 178 | 9298 | 2174 | 5Q | S3A | 9201 |
| * 0202398 | 5212 | 492 | 65885 | 3372 | 3R | | 9307 |
| * 0202399 | 3930 | 291 | 52947 | 2474 | 6N | US3A | 9003 |
| * 0202400 | 5271 | 808 | 9353 | 2474 | 6N | S3B | 9310 |
| * 0202401 | 4167 | 305 | 65885 | 3372 | 3A | | 8911 |
| * 0202401 | 4803 | 26 | 9539 | 2474 | 3P | S3B | 9108 |
| * 0202401 | 4855 | 52 | 9539 | 2474 | 3R | S3B | 9203 |
| * 0202402 | 5027 | 2128 | 9353 | 2474 | 1Z | S3A | 9003 |
| * 0202402 | 5474 | 447 | 9572 | 2474 | 8F | S3B | 9207 |
| * 0202402 | 5671 | 197 | 5556C | 2474 | 2S | ES3A | 9406 |
| * 0202403 | 4299 | 1165 | 9539 | 2474 | 3T | S3B | 8911 |
| * 0202403 | 5027 | 728 | 9226 | 2474 | 3R | S3B | 9201 |
| * 0202404 | 5064 | 509 | 9629 | 2474 | 5B | S3B | 9102 |
| * 0202404 | 5107 | 43 | 9629 | 2474 | 2N | S3B | 9204 |
| * 0202405 | 3679 | 240 | 9263 | 2474 | 2N | S3B | 9210 |
| * 0202406 | 3635 | 830 | 9353 | 2474 | 1Z | S3B | 9108 |
| * 0202406 | 3650 | 15 | 55566 | 2474 | 7K | S3A | 9204 |
| * 0202406 | 4216 | 566 | 9739 | 2474 | 1Z | S3B | 9308 |
| * 0202406 | 4430 | 214 | 9192 | 2474 | 6F | S3B | 9406 |
| * 0202409 | 5098 | 691 | 9739 | 2474 | 8B | S3B | 9111 |
| * 0202409 | 5845 | 747 | 9739 | 2474 | 7L | S3B | 9405 |
| * 0202410 | 4463 | 1176 | 65885 | 3372 | 3A | | 9003 |
| * 0202410 | 5639 | 3 | 9539 | 2474 | 3T | S3B | 9304 |
| * 0202412 | 4616 | 1613 | 65885 | 3372 | 3A | | 9102 |
| * 0202413 | 5031 | 523 | 9539 | 2474 | 1Z | S3B | 9309 |
| * 0202413 | 5033 | 2 | 9539 | 2474 | 3B | S3B | 9312 |
| * 0202415 | 4755 | 435 | 9646 | 2474 | 6C | S3B | 9106 |
| * 0202417 | 4806 | 1164 | 65885 | 3372 | 3A | | 8911 |
| * 0202419 | 1873 | 686 | 9739 | 2474 | 1W | S3A | 8910 |
| * 0202419 | 1921 | 48 | 52947 | 2474 | 1W | US3A | 9001 |
| * 0202419 | 2413 | 492 | 52947 | 2474 | 6N | US3A | 9202 |
| * 0202420 | 4405 | 226 | 9572 | 2474 | 7K | S3B | 8910 |
| * 0202420 | 4899 | 494 | 9353 | 2474 | 6F | S3B | 9104 |
| * 0202421 | 4244 | 798 | 55567 | 2474 | 5Q | ES3A | 9302 |
| * 0202423 | 4232 | 1399 | 9539 | 2474 | 5C | S3B | 9011 |
| * 0202424 | 4268 | 785 | 9298 | 2474 | 9C | S3A | 9106 |

## APPENDIX C. FAILURE TIME BETWEEN REPAIRS

| SERNO | FHSN | FHSR | REM-UIC | SSC | REA-REM | A/C | START DATE |
|---|---|---|---|---|---|---|---|
| * 0202424 | 4511 | 243 | 9298 | 2474 | 1W | S3A | 9201 |
| * 0202424 | 4980 | 469 | 9204 | 2474 | 5W | S3B | 9303 |
| * 0202426 | 5476 | 1008 | 9226 | 2474 | 3T | S3B | 9108 |
| * 0202426 | 5523 | 47 | 65885 | 2374 | 3A | S3A | 9208 |
| * 0202426 | 5523 | 47 | 65885 | 3372 | 3A | | 9211 |
| * 0202427 | 4540 | 345 | 9646 | 2474 | 2N | S3B | 9102 |
| * 0202428 | 3119 | 162 | 9629 | 2474 | 3Q | S3B | 9004 |
| * 0202428 | 3635 | 516 | 65885 | 3372 | 6Q | | 9210 |
| * 0202431 | 3949 | 441 | 9739 | 2474 | 1G | S3B | 9105 |
| * 0202432 | 4527 | 1379 | 9226 | 2474 | 3Q | S3B | 9104 |
| * 0202432 | 4573 | 46 | 9539 | 2474 | 1Z | S3A | 9111 |
| * 0202433 | 3892 | 1157 | 65885 | 3372 | 3A | | 9111 |
| * 0202437 | 4948 | 313 | 52947 | 2474 | 6F | US3A | 9008 |
| * 0202437 | 5018 | 70 | 52947 | 2474 | 3R | US3A | 9102 |
| * 0202437 | 5398 | 380 | 9192 | 2474 | 3R | S3A | 9306 |
| * 0202438 | 5418 | 1419 | 9539 | 2474 | 5W | S3B | 9207 |
| * 0202439 | 4403 | 811 | 9298 | 2474 | 3Q | S3A | 9001 |
| * 0202439 | 4552 | 149 | 65885 | 3372 | 1Z | | 9012 |
| * 0202439 | 5405 | 853 | 9192 | 2474 | 6F | S3B | 9402 |
| * 0202440 | 4588 | 116 | 9204 | 2474 | 4P | S3A | 9003 |
| * 0202440 | 5149 | 561 | 9739 | 2474 | 7A | S3B | 9202 |
| * 0202441 | 5946 | 559 | 65885 | 3372 | 1Z | | 9310 |
| * 0202442 | 5080 | 1279 | 9381 | 2474 | 1G | S3B | 9209 |
| * 0202443 | 5347 | 1362 | 65885 | 3372 | 3A | | 9212 |
| * 0202443 | 5445 | 98 | A9028 | 2474 | 7K | ES3A | 9311 |
| * 0202443 | 5642 | 197 | 5556B | 2474 | 7J | S3A | 9406 |
| * 0202444 | 4656 | 37 | 9353 | 2474 | 1Z | S3B | 9009 |
| * 0202444 | 4660 | 4 | 9646 | 2474 | 1Z | S3B | 9101 |
| * 0202444 | 5171 | 511 | 9572 | 2474 | 5W | S3B | 9201 |

## APPENDIX D. FORMULAS FOR COMPUTING NO-BUILD TIMES

### A. OPTIMUM TIME EQUATION FOR SETTING $t_0$

Notation used in this appendix is given on page 40 of this thesis. If IR is performed on the SI component at the time of engine failure, with $t_0$ operating hours on the component, the IR cost per unit time is $C_N/t_0$. If the decision is made to wait for the next engine failure and the SI component survives that remaining time the average IR cost per unit time is approximately

$$C_N \int_0^{T_0 - t_0} \frac{1}{t_0 + t} f_e(t) \bar{F}(t + t_0 \setminus t_0) dt \cong \left[ C_N \int_0^{T_0 - t_0} \frac{1}{t_0 + t} f_e(t) dt \right] \bar{F}(T_0 \setminus t_0). \qquad (13)$$

The approximation indicated in equation (13) will be very good if the residual reliability $\bar{F}(T_0 \setminus t_0)$ is close to one, which will probably be the case because the high time $T_0$ is set so that $\bar{F}(T_0)$ is close to one and $\bar{F}(T_0 \setminus t_0) > \bar{F}(T_0)$. See equation (17).

If IR is not performed on the SI component at the time of engine failure, $t_e$, and if there is no engine failure in the first $T_0 - t_0$ time units after it is returned to service, the average IR cost per unit time for the SI component is,

$$\frac{C_I}{T_0} \bar{F}_e(T_0 - t_0) \bar{F}(T_0 \setminus t_0). \qquad (14)$$

If the decision is made not to repair the SI component at the time of engine failure, and the SI component fails between operating time $t_0$ and $T_0$ and if $C_F$ is the cost of repairing this component when it fails, then the cost per unit time is determined using the equation

$$C_F \int_{t_0}^{T_0} \frac{1}{t} f(t \setminus t_0) dt \cong \frac{C_F}{T_0} F(T_0 \setminus t_0), \qquad (15)$$

where $f(t \setminus t_0)$ is the conditional density function of the time to failure of the SI component given it is still operating at time $t_0$.

The expression

$$\frac{C_F}{T_0} F(T_0 \setminus t_0) \tag{16}$$

will likely be quite small because $F(T_0 \setminus t_0)$ is smaller than $F(T_0)$ which is itself very small because the HT time, $T_0$, is chosen to make an SI failure highly unlikely before time $T_0$. That is,

$$F(T_0 \setminus t_0) = P(T < T_0 \setminus T > t_0) = \frac{P(t_0 < T < T_0)}{P(t > t_0)} = \frac{P(T > t_0) - P(T > T_0)}{P(t > t_0)}$$
$$= 1 - \frac{P(T > T_0)}{P(T > t_0)} < 1 - P(T > T_0) = F(T_0). \tag{17}$$

In equation (16), if $T_0 = 1000$ hours and $F(T_0 \setminus t_0) = 0.01$, then

$$\frac{C_F}{T_0} F(T \setminus t_0) = C_F(0.00001). \tag{18}$$

If $C_F = \$1{,}000{,}000$, this average cost per unit time expression would be \$10/hour.

The total equation to solve for the optimum time $t_0$ is given in equation (19).

$$\frac{C_N}{t_0} = C_N \int_0^{T_0 - t_0} \frac{1}{t + t_0} f_e(t) \bar{F}(t + t_0 \setminus t_0) dt + \frac{C_I}{T_0} \bar{F}_e(T_0 - t_0) \bar{F}(T_0 - t_0)$$
$$+ C_F \int_{t_0}^{T_0} \frac{1}{t} f(t \setminus t_0) dt \tag{19}$$

## APPENDIX D. FORMULAS FOR COMPUTING NO-BUILD TIMES

Dropping the last term in equation (19) (because it is small) and using the approximation given in equation (13), yields the equation

$$\frac{C_N}{t_0} = \left[ C_N \int_0^{T_0 - t_0} \frac{1}{t + t_0} f_e(t)dt + \frac{C_I}{T_0} \bar{F}_e(T_0 - t_0) \right] \bar{F}(T_0 \setminus t_0). \qquad (20)$$

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